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AMTOR EQUIPMENT DESIGNERS

Gentlemen:

Enclosed are copies of International Radio Consultative Committee (CCIR) Recommendations 476-4, 491-1 and 625, which concern AMTOR.

The FCC rules in paragraph 97.69 (b)(3) provide that AMTOR "code, baud rate and emission timing shall conform to the specifications of CCIR 476-2 (1978) or CCIR 476-3 (1982), Mode A or Mode B."

Rec. 476-4 does not appear to have any substantive changes over 476-3 but simply states that 476-4 applies to existing equipment but that new equipment should conform to Rec. 625. Rec. 625 has a few subtle changes, such as:

1.2 The clock controlling the modulation rate should have an accuracy of 30 parts in 10\6/ or better.

1.4 The receiver 6-dB bandwidth should preferably be between 270 and 340 Hz.

1.7 Describes introduction of a longer time interval, e.g., 20-40 ms, between the end of the received signal and the start of the transmitted signal, for short distances.

Table I Symbols are added for space and no information.

Table II Control signals 4 and 5 are added.

2.5 Check-sum signal derivation is new.

3 and 4 These paragraphs are reorganized.

Appendixes Mainly, SDL diagrams are added.

Please look over these new CCIR recommendations and let me know what, if any, impact there will be on the design of future AMTOR equipment and interoperability of such new equipment with existing AMTOR equipment. On the surface, it appears that paragraph 97.69(b)(3) of the FCC rules should be changed to read:

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"(3) The International Radio Consultative Committee (CCIR) Recommendations 476-2 and 476-3 (commonly known as AMTOR); provided that the code, baud rate and emission timing shall conform to the specifications of Mode A or Mode B of CCIR 476-2 (1978), CCIR 476-3 (1982), CCIR 476-4 (1986), or CCIR 625 (1986), as appropriate."

I would appreciate your letting me know by May 15. It is my intent to bring up this subject at the next Digital Committee meeting, which will be May 23, 1987 at ARRL HQ. At that meeting, we will consider the exact wording of a draft petition to be considered by the ARRL Board to the FCC for updating section 97.69 of the rules.

73,

Paul L. Rinaldo, W4RI
Chairman, Ad Hoc Committee on
Amateur Radio Digital Communication

Enclosures:

CCIR Recs. 476-4, 491-1, and 625

RECOMMENDATION 476-4*

DIRECT-PRINTING TELEGRAPH EQUIPMENT IN THE MARITIME MOBILE SERVICE**

(Question 5/8)

(1970-1974-1978-1982-1986)

The CCIR,

CONSIDERING

(a) that there is a requirement to interconnect mobile stations, or mobile stations and coast stations, equipped with start-stop apparatus employing the International Telegraph Alphabet No. 2, by means of radiotelegraph circuits;

(b) that direct-printing telegraphy communications in the maritime mobile service can be listed in the following categories:

b.a telegraph service between a ship and a coast station;

b.b telegraph service between a ship and an extended station (ship's owner) via a coast station;

b.c telex service between a ship and a subscriber of the (international) telex network;

b.d broadcast telegraph service from a coast station to one or more ships;

b.e telegraph service between two ships or between one ship and a number of other ships;

(c) that those categories are different in nature and that consequently different degrees of transmission quality may be required;

(d) that the categories given in *b.a*, *b.b* and *b.c* above may require a higher transmission quality than categories *b.d* and *b.e* for the reason that data could be handled through the services in the categories *b.a*, *b.b* and *b.c*, while the messages passed through the service of category *b.d*, and via the broadcast service of category *b.e* are normally plain language, allowing a lower transmission quality than that required for coded information;

(e) that the service in category *b.d* and the broadcast service in category *b.e* cannot take advantage of an ARQ method, as there is in principle no return path;

(f) that for these categories of service which by their nature do not allow the use of ARQ, another mode, i.e. the forward error-correcting (FEC) mode should be used;

(g) that the period for synchronization and phasing should be as short as possible and should not exceed 5 seconds;

(h) that most of the ship stations do not readily permit simultaneous use of the radio transmitter and radio receiver;

(j) that the equipment on board ships should be neither unduly complex nor expensive;

(k) that provision is made in Appendix 38 of the Radio Regulations for direct-printing telegraph operation,

UNANIMOUSLY RECOMMENDS

1. that when an error-detecting and correcting system is used for direct-printing telegraphy in the maritime mobile service, a 7-unit ARQ system or a 7-unit forward acting, error-correcting and indicating time-diversity system, using the same code, should be employed;

2. that equipment designed in accordance with § 1 should meet the characteristics laid down in Annex I.

ANNEX I

1. General (Mode A, ARQ and Mode B, FEC)

1.1 The system is a single-channel synchronous system using the 7-unit error-detecting code as listed in § 2 of this Annex.

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* The Director, CCIR is requested to bring this Recommendation to the attention of the CCITT.

** This Recommendation is retained in order to provide information concerning existing equipment, but will probably be deleted at a later date. New equipment should conform to Recommendation 625 which provides for the exchange of identification signals, for the use of 9 digit maritime mobile service identification signals and for compatibility with existing equipment built in accordance with this Recommendation.

1.2 The modulation rate on the radio link is 100 bauds. The equipment clocks controlling the modulation rate should have an accuracy of better than 30 parts in 10^6.

Note. – Some existing equipments may not conform to this requirement.

1.3 The terminal input must be able to accept the 5-unit start-stop CCITT International Telegraph Alphabet No. 2 at a modulation rate of 50 bauds.

1.4 The frequency shift on the radio link is 170 Hz. When frequency shift is effected by applying audio signals to the input of a transmitter, the centre frequency of the audio spectrum offered to the transmitter should be 1700 Hz.

Note. – A number of equipments are presently in service, using a centre frequency of 1500 Hz. These may require special measures to achieve compatibility.

1.5 The radio frequency tolerance of the transmitter and the receiver should be in accordance with Appendix 38 of the Radio Regulations. It is desirable that the receiver employs the minimum practicable bandwidth (see also Report 585).

Note. – The receiver bandwidth should preferably be between 270 and 340 Hz.

2. Table of conversion

2.1 *Traffic information signals*

TABLE I

Combination No.	Letter-case	Figure-case	International Telegraph Alphabet No. 2 Code	Emitted 7-unit signal(1)
1	A	—	ZZAAA	BBBYYYB
2	B	?	ZAAZZ	YBYYBBB
3	C	:	AZZZA	BYBBBYY
4	D	⊠(3)	ZAAZA	BBYYBYB
5	E	3	ZAAAA	YBBYBYB
6	F	(2)	ZAZZA	BBYBBYY
7	G	(2)	AZAZZ	BYBYBBY
8	H	(2)	AAZAZ	BYYBYBB
9	I	8	AZZAA	BYBBYYB
10	J	Audible signal	ZZAZA	BBBYBYY
11	K	(	ZZZZA	YBBBBYY
12	L	)	AZAAZ	BYBYYBB
13	M	.	AAZZZ	BYYBBBY
14	N	,	AAZZA	BYYBBYB
15	O	9	AAAZZ	BYYYBBB
16	P	0	AZZAZ	BYBBYBY
17	Q	1	ZZZAZ	YBBBYBY
18	R	4	AZAZA	BYBYBYB
19	S	'	ZAZAA	BBYBYYB
20	T	5	AAAAZ	YYBYBBB
21	U	7	ZZZAA	YBBBYYB
22	V	=	AZZZZ	YYBBBBY
23	W	2	ZZAAZ	BBBYYBY
24	X	/	ZAZZZ	YBYBBBY
25	Y	6	ZAZAZ	BBYBYBY
26	Z	+	ZAAAZ	BBYYYBB
27	←	(Carriage return)	AAAZA	YYYBBBB
28	▬	(Line feed)	AZAAA	YYBBYBB
29	↓	(Letter shift)	ZZZZZ	YBYBBYB
30	↑	(Figure shift)	ZZAZZ	YBBYBBY
31		Space	AAZAA	YYBBBYB
32		Unperforated tape	AAAAA	YBYBYBB

(1) B represents the higher emitted frequency and Y the lower.

(2) At present unassigned (see CCITT Rec. F.1 C8). Reception of these signals, however, should not initiate a request for repetition.

(3) The pictorial representation shown is a schematic of ✠ which may also be used when equipment allows (CCITT Rec. F.1).

2.2 *Service information signals*

TABLE II

Mode A (ARQ)	Emitted signal	Mode B (FEC)
Control signal 1 (CS1)	**BYBYYBB**	
Control signal 2 (CS2)	**YBYBYBB**	
Control signal 3 (CS3)	**BYYBBYB**	
Idle signal β	**BBYYBBY**	
Idle signal α	**BBBBYYY**	**Phasing signal 1**
Signal repetition	**YBBYYBB**	**Phasing signal 2**

3. Characteristics

3.1 *Mode A (ARQ)* (see Figs. 1 and 2)

A synchronous system, transmitting blocks of three characters from an information sending station (ISS) towards an information receiving station (IRS), which stations can, controlled by the control signal 3 (see § 2.2), interchange their functions.

3.1.1 *Master and slave arrangements*

3.1.1.1 The station that initiates the establishment of the circuit (the calling station) becomes the "master" station, and the station that has been called will be the "slave" station;

this situation remains unchanged during the entire time in which the established circuit is maintained, regardless of which station, at any given time, is the Information Sending Station (ISS) or Information Receiving Station (IRS);

3.1.1.2 the clock in the master station controls the entire circuit (see circuit timing diagram, Fig. 1);

3.1.1.3 the basic timing cycle is 450 ms, and for each station consists of a transmission period followed by a transmission pause during which reception is effected;

3.1.1.4 the master station transmitting time distributor is controlled by the clock in the master station;

3.1.1.5 the slave station receiving time distributor is controlled by the received signal;

3.1.1.6 the slave station transmitting time distributor is phase-locked to the slave station receiving time distributor; i.e. the time interval between the end of the received signal and the start of the transmitted signal (t_E in Fig. 1) is constant;

3.1.1.7 the master station receiving time distributor is controlled by the received signal.

3.1.2 *The Information Sending Station (ISS)*

3.1.2.1 Groups the information to be transmitted into blocks of three characters (3 × 7 signal elements), including, if necessary, "idle signals β" to complete or to fill blocks when no traffic information is available;

3.1.2.2 emits a "block" in 210 ms after which a transmission pause of 240 ms becomes effective, retaining the emitted block in memory until the appropriate control signal confirming correct reception by the Information Receiving Station (IRS) has been received;

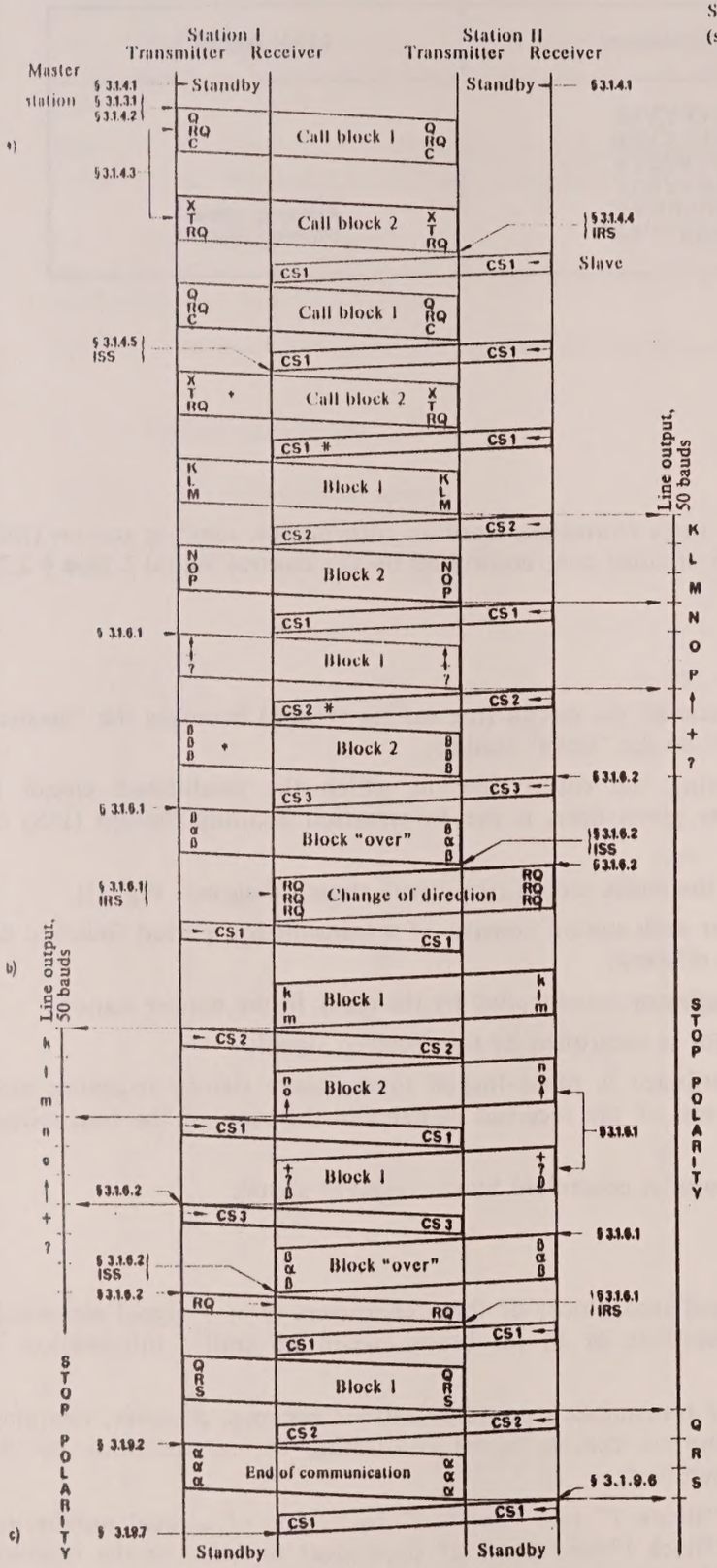
3.1.2.3 numbers successive blocks alternately "Block 1" and "Block 2" by means of a local numbering device. The first block should be numbered "Block 1" or "Block 2" dependent on whether the received control signal (see § 3.1.4.5) is a control signal 1 or a control signal 2. The numbering of successive blocks is interrupted at the reception of:

- a request for repetition; or
- a mutilated signal; or
- a control signal 3 (see § 2.2);

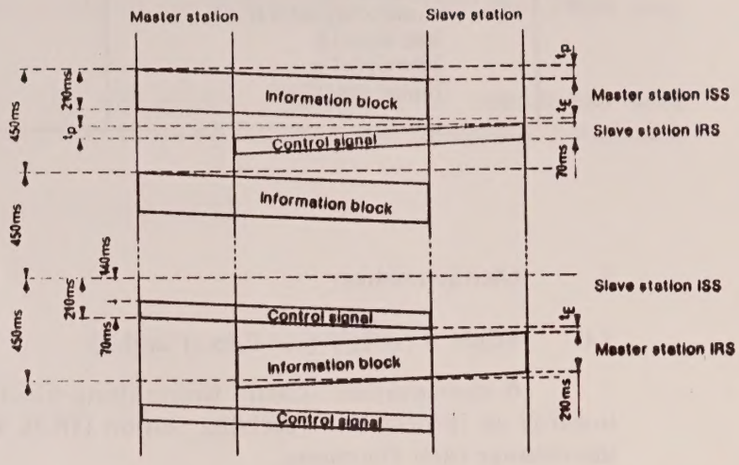
3.1.2.4 emits the information of Block 1 on receipt of control signal 1 (see § 2.2);

3.1.2.5 emits the information of Block 2 on receipt of control signal 2 (see § 2.2);

3.1.2.6 emits a block of three "signal repetitions" on receipt of a mutilated signal (see § 2.2).



*The transmission of these signals may be omitted.



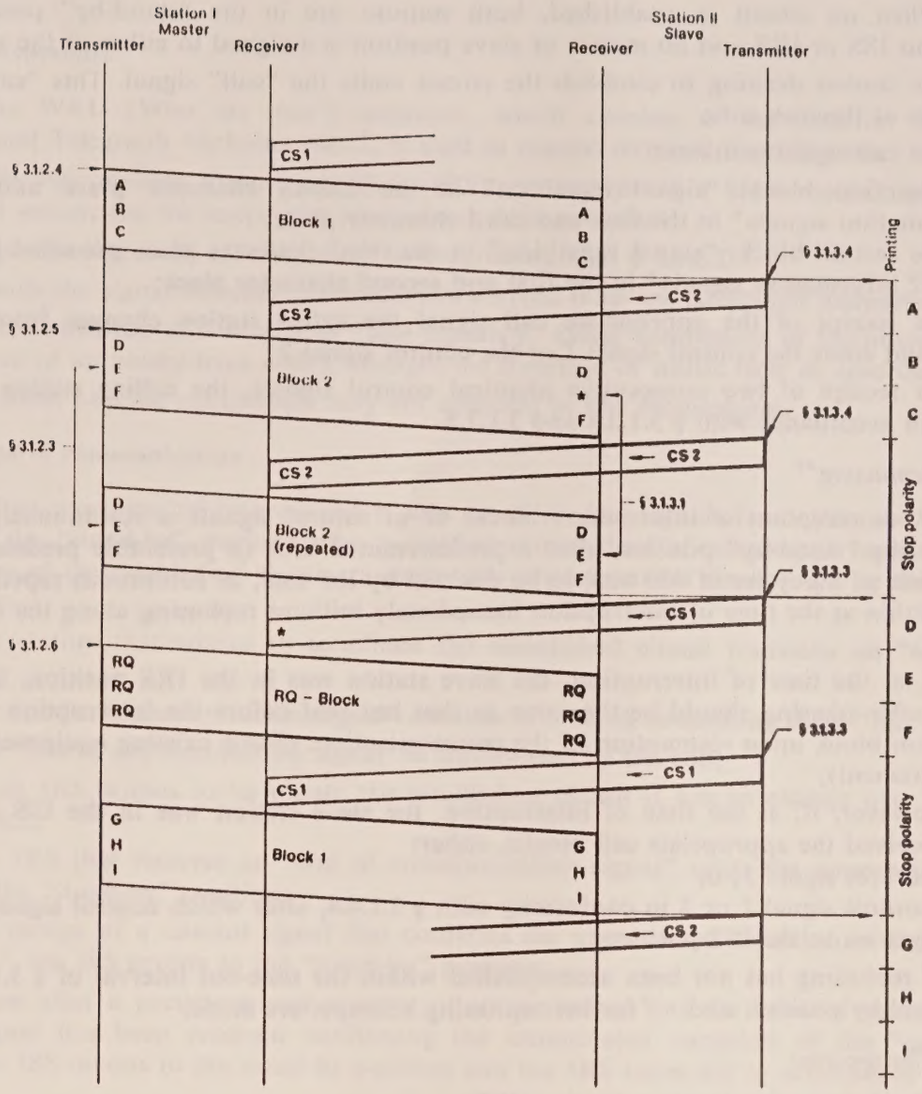
Basic timing cycle

FIGURE 1 – *A-Mode operation*

a) Start of communication
b) Change of the direction of the traffic flow
c) End of communication
CS: Control signal

ISS: Information sending station
IRS: Information receiving station
RQ: Signal repetition information signal

t: Figure shift
t_p: (One way) propagation time
t_E: (Fixed) equipment delay



* Detected error Symbol.

FIGURE 2 – *Mode A under error receiving conditions*

3.1.3 *The Information Receiving Station (IRS)*

3.1.3.1 Numbers the received blocks of three characters alternately "Block 1" and "Block 2" by a local numbering device, the numbering being interrupted at the reception of:

- a block in which one or more characters are mutilated; or
- a block containing at least one "signal repetition"; (3.1.2.6)

3.1.3.2 after the reception of each block, emits one of the control signals of 70 ms duration after which a transmission pause of 380 ms becomes effective;

3.1.3.3 emits the control signal 1 at the reception of:

- an unmutilated "Block 2", or
- a mutilated "Block 1", or
- Block 1" containing at least one "signal repetition";

3.1.3.4 emits the control signal 2 at reception of:

- an unmutilated "Block 1", or
- a mutilated "Block 2", or
- a "Block 2" containing at least one "signal repetition".

3.1.4 *Phasing*

3.1.4.1 When no circuit is established, both stations are in the "stand-by" position. In this stand-by position no ISS or IRS and no master or slave position is assigned to either of the stations;

3.1.4.2 the station desiring to establish the circuit emits the "call" signal. This "call" signal is formed by two blocks of three signals;

3.1.4.3 the call signal contains:

- in the first block: "signal repetition" in the second character place and any combination of information signals* in the first and third character place,
- in the second block: "signal repetition" in the third character place preceded by any combination of the 32 information signals* in the first and second character place;

3.1.4.4 on receipt of the appropriate call signal the called station changes from stand-by to the IRS position and emits the control signal 1 or the control signal 2;

3.1.4.5 on receipt of two consecutive identical control signals, the calling station changes into ISS and operates in accordance with § 3.1.2.4 and 3.1.2.5.

3.1.5 *Rephasing***

3.1.5.1 When reception of information blocks or of control signals is continuously mutilated, the system reverts to the "stand-by" position after a predetermined time (a preferable predetermined time would be the duration of 32 cycles of 450 ms), to be decided by the user, of continuous repetition; the station that is master station at the time of interruption immediately initiates rephasing along the same lines as laid down in § 3.1.4;

3.1.5.2 if, at the time of interruption, the slave station was in the IRS position, the control signal to be returned after phasing should be the same as that last sent before the interruption to avoid the loss of an information block upon resumption of the communication. (Some existing equipments may not conform to this requirement);

3.1.5.3 however, if, at the time of interruption, the slave station was in the ISS position, it emits, after having received the appropriate call blocks, either:

- the control signal 3; or
- the control signal 1 or 2 in conformity with § 3.1.4.4, after which control signal 3 is emitted to initiate changeover to the ISS position;

3.1.5.4 if rephasing has not been accomplished within the time-out interval of § 3.1.9.1, the system reverts to the stand-by position and no further rephasing attempts are made.

3.1.6 *Change-over*

3.1.6.1 *The Information Sending Station (ISS)*

- Emits, to initiate a change in the direction of the traffic flow, the information signal sequence "Figure shift" – "Plus" ("figure case of *Z*") – "Question Mark" ("figure case of *B*")*** followed, if necessary, by one or more "Idle Signals β" to complete a block;
- emits, on receipt of a control signal 3, a block containing the signals "Idle Signal β" – "Idle Signal α" – "Idle Signal β";
- changes subsequently to IRS after the reception of a "signal repetition".

3.1.6.2 *The Information Receiving Station (IRS)*

- Emits the control signal 3:
  (a) when the station wishes to change over to ISS,
  (b) on receipt of a block in which the signal information sequence "Figure shift" – "Plus" – (figure-case of Z) – "Question Mark" (figure-case of B) terminates*** or upon receipt of the following block. In the latter case, the IRS shall ignore whether or not one or more characters in the last block are mutilated:
- changes subsequently to ISS after reception of a block containing the signal sequence "Idle signal β" – "Idle signal α" "Idle signal β";
- emits one "signal repetition" as a master station, or a block of three "signal repetitions" as a slave station, after being changed into ISS;

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* The composition of these signals and their assignment to individual ships require international agreement (see Recommendation 491).

** Some coast stations do not provide rephasing (see also Recommendation 492).

*** In the Telex network, the signal sequence combination No. 26 – combination No. 2, sent whilst the teleprinters are in the figure case condition, is used to initiate a reverasl of the flow of information. The IRS is, therefore, required to keep track of whether the traffic information flow is in the letter-case or figure-case mode to ensure proper end-to-end operation of the system.

3.1.7 *Output to line*

3.1.7.1 the signal offered to the line output terminal is a 5-unit start-stop signal at a modulation rate of 50 bauds.

3.1.8 *Answerback*

3.1.8.1 The WRU (Who are you?) sequence, which consists of combination Nos. 30 and 4 in the International Telegraph Alphabet No. 2, is used to request terminal identification.

3.1.8.2 The Information Receiver Station (IRS), on receipt of a block containing the WRU sequence, which will actuate the the teleprinter answerback code generator:

- changes the direction of traffic flow in accordance with § 3.1.6.2;
- transmits the signal information characters derived from the teleprinter answerback code generator;
- after transmission of 2 blocks of "Idle signals β" (after completion of the answerback code, or in the absence of an answerback code), changes the direction of traffic flow in accordance with § 3.1.6.1.

Note. – Some existing equipments may not conform to this requirement.

3.1.9 *End of communication*

3.1.9.1 When reception of information blocks or of control signals is continuously mutilated, the system reverts to the "stand-by" position after a predetermined time of continuous repetition, which causes the termination of the established circuit, (a preferable predetermined time would be the duration of 64 cycles of 450 ms);

3.1.9.2 the station that wishes to terminate the established circuit transmits an "end of communication signal";

3.1.9.3 the "end of communication signal" consists of a block containing three "Idle Signal α";

3.1.9.4 the "end of communication signal" is transmitted by the ISS;

3.1.9.5 if an IRS wishes to terminate the established circuit it has to change over to ISS in accordance with § 3.1.6.2;

3.1.9.6 the IRS that receives an "end of communication signal" emits the appropriate control signal and reverts to the "stand-by" position;

3.1.9.7 on receipt of a control signal that confirms the unmutilated reception of the "end of communication signal", the ISS reverts to the "stand-by" position;

3.1.9.8 when after a predetermined number of transmissions* of the "end of communication signal" no control signal has been received confirming the unmutilated reception of the "end of communication signal", the ISS reverts to the stand-by position and the IRS times out in accordance with § 3.1.9.1.

3.2 *Mode B, forward error correction (FEC)* (see Figs. 3 and 4)

A synchronous system, transmitting an uninterrupted stream of characters from a station sending in the collective B-mode (CBSS) to a number of stations receiving in the collective B-mode (CBRS), or from a station sending in the selective B-mode (SBSS) to one selected station receiving in the selective B-mode (SBRS).

3.2.1 *The station sending in the collective or in the selective B-mode (CBSS or SBSS)*

3.2.1.1 Emits each character twice: the first transmission (DX) of a specific character is followed by the transmission of four other characters, after which the retransmission (RX) of the first character takes place, allowing for time-diversity reception at 280 ms time space;

3.2.1.2 emits as a preamble to messages or to the call sign, alternately the phasing signal 1 (see § 2.2) and the phasing signal 2 (see § 2.2) whereby phasing signal 1 is transmitted in the RX, and phasing signal 2 in the DX position. At least four of these signal pairs (phasing signal 1 and phasing signal 2) should be transmitted.

3.2.2 *The station sending in the collective B-mode (CBSS)*

3.2.2.1 Emits during the breaks between two messages in the same transmission the phasing signals 1 and the phasing signals 2 in the RX and the DX position, respectively.

3.2.3 *The station sending in the selective B-mode (SBSS)*

3.2.3.1 Emits after the transmission of the required number of phasing signals (see § 3.2.1.2) the call sign of the station to be selected. This call sign is a sequence of four characters that represents the number code of the called station. This transmission takes place in the time diversity mode according to § 3.2.1.1;

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* A preferable predetermined number would be four transmissions of the "end of communication signal".

3.2.3.2 emits the call sign and all further signals in a 3B/4Y ratio, i.e. inverted with respect to the signals in Table I of § 2 in the column "emitted 7-unit signal". Consequently, all signals, i.e. both traffic information signals and service information signals, following the phasing signals are transmitted in the 3B/4Y ratio;

3.2.3.3 emits the service information signal "Idle signal β" during the idle time between the messages consisting of traffic information signals.

3.2.4 *The station(s) receiving in the collective or in the selective B-mode (CBRS or SBRS)*

3.2.4.1 Checks both characters (DX and RX), printing an unmutilated DX or RX character, or printing an error symbol or space, if both are mutilated.

3.2.5 *Phasing*

3.2.5.1 When no reception takes place, the system is in the "stand-by" position as laid down in § 3.1.4.1;

3.2.5.2 on receipt of the sequence *"phasing signal 1" – "phasing signal 2"*, or of the sequence *"phasing signal 2" – "phasing signal 1"*, in which phasing signal 2 determines the DX and phasing signal 1 determines the RX position, and at least one further phasing signal in the appropriate position, the system changes from "stand-by" to the CBRS position;

3.2.5.3 when started as CBRS the system changes to the SBRS (selectively called receiving station) position on receipt of the inverted characters representing its selective call number;

3.2.5.4 having been changed into the CBRS or into the SBRS position the system offers continuous stop-polarity to the line output terminal until either the signal "carriage return" or "line feed" is received;

3.2.5.5 when started as SBRS, the decoder re-inverts all the following signals received to the 3Y/4B ratio, so that these signals are offered to the SBRS in the correct ratio, but they remain inverted for all other stations;

3.2.5.6 both the CBRS and the SBRS revert to the stand-by position if, during a predetermined time, the percentage of mutilated signals received has reached a predetermined value.

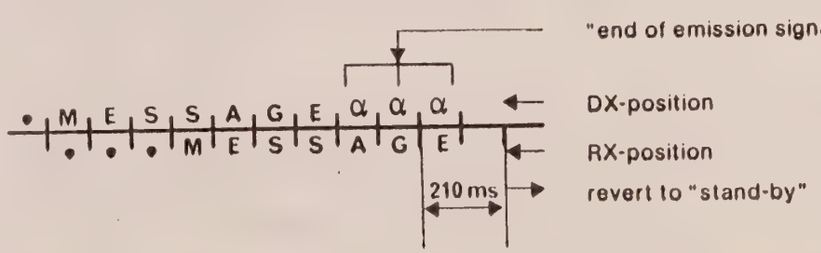
3.2.6 *Output to line*

3.2.6.1 The signal offered to the line output terminal is a 5-unit start-stop CCITT International Telegraph Alphabet No. 2 signal at a modulation rate of 50 bauds.

3.2.7 *End of emission*

3.2.7.1 The station sending in the B-mode (CBSS or SBSS) that wishes to terminate the emission transmits the "end of emission signal";

3.2.7.2 the "end of emission signal" consists of three consecutive "idle signals α" (see § 2.2) transmitted in the DX position only, immediately after the last transmitted traffic information signal in the DX position, after which the station terminates its emission and reverts to the "stand-by" position;



3.2.7.3 the CBRS or the SBRS reverts to the "stand-by" position not less than 210 ms after receipt of at least two consecutive "idle signals α" in the DX position.

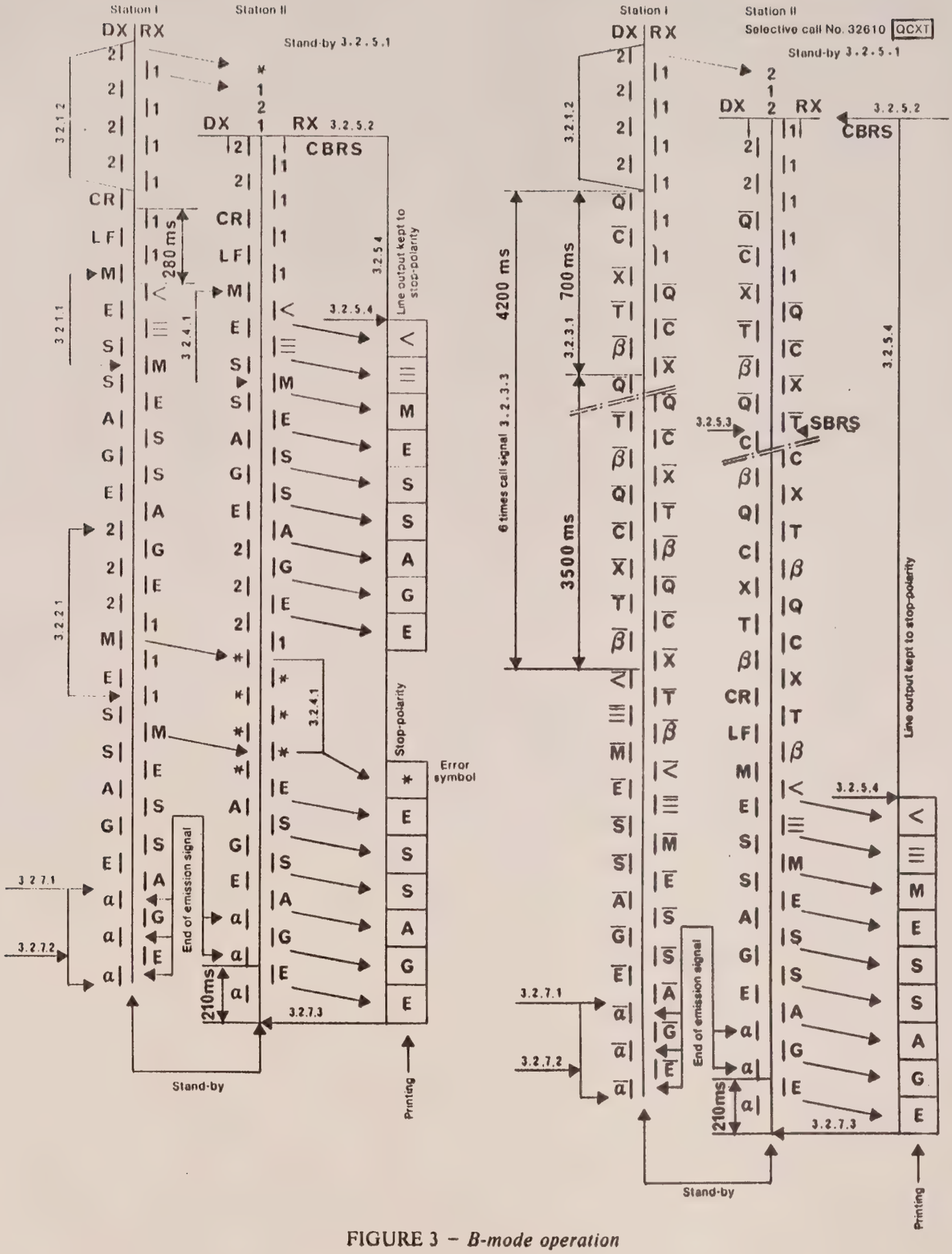


FIGURE 3 – *B-mode operation*

Collectively
1: Phasing signal 1
2: Phasing signal 2
<: Carriage return (CR)
▬: Line feed (LF)
*: Detected error symbol

Selectively
CBSS: B-mode – Sending collectively
CBRS: B-mode – Receiving collectively
SBSS: B-mode – Sending selectively
SBRS: B-mode – Receiving selectively

Overlined symbols (e.g. $\overline{M}$) are transmitted in the 3B/4Y ratio

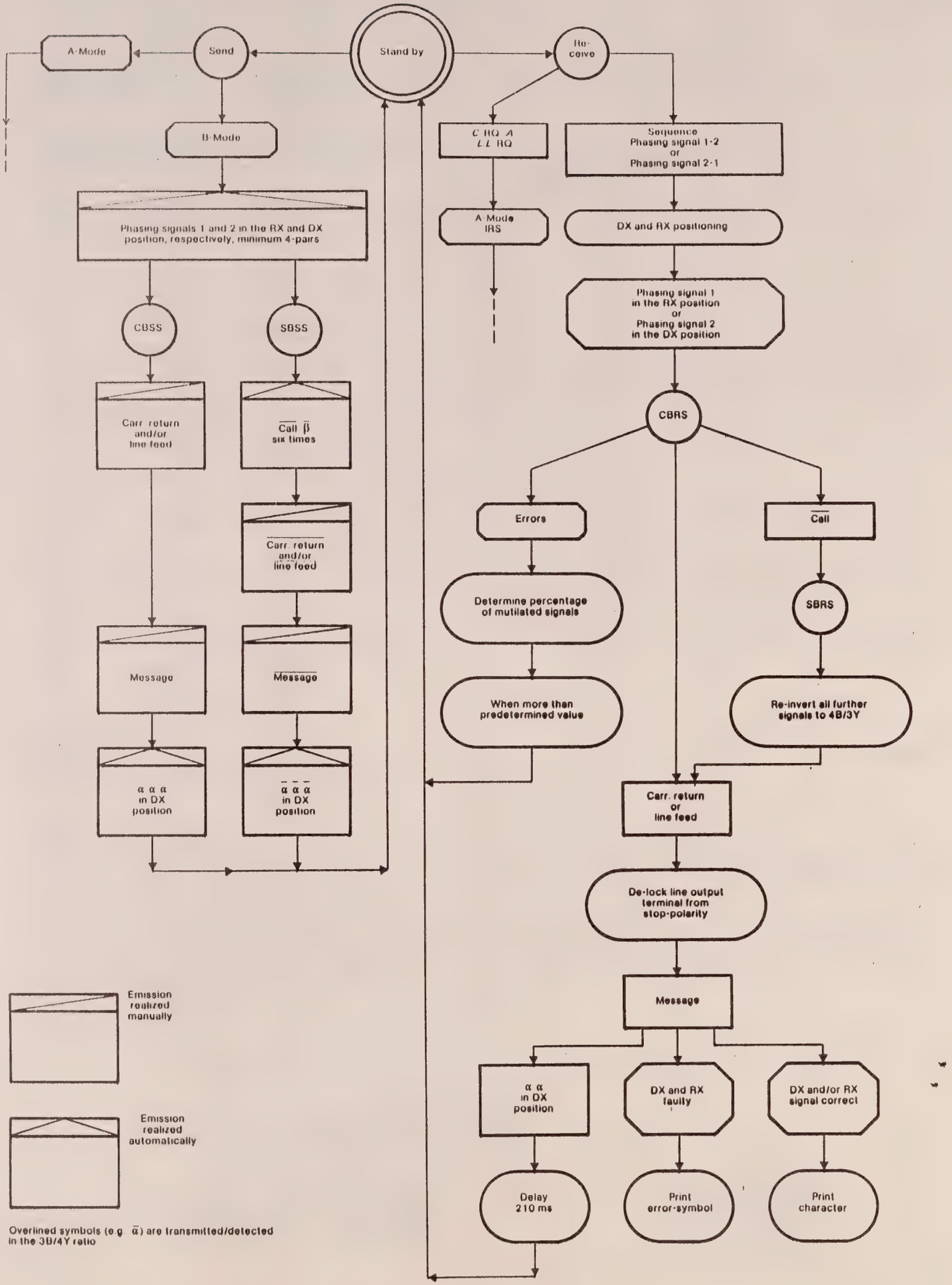


FIGURE 4 – *Flow chart showing processes in B-Mode operation*

TABLE I

Frequency of emission	Circuits using teleprinter or punched tape equipment					
	International Telegraph Alphabet No. 2				Emitted 7-unit signal	Telex
Higher frequency	Space	Start	No perforation	A (1)	B (2)	Free line condition
Lower frequency	Mark	Stop	Perforation	Z (1)	Y (2)	Idle circuit condition

(1) on a wire circuit.
(2) on a radio channel.

RECOMMENDATION 491-1

TRANSLATION BETWEEN AN IDENTITY NUMBER AND IDENTITIES FOR DIRECT-PRINTING TELEGRAPHY IN THE MARITIME MOBILE SERVICE

(Question 5/8)

(1974-1986)

The CCIR,

CONSIDERING

(a) that, according to Article 25 of the Radio Regulations, a station shall be identified either by a call sign or by other recognized means of identification, such as a ship station selective call number or signal, or coast station selective call number or signal;

(b) that the call signals described in Recommendations 476 and 625 effectively provide for selective-calling numbers for use with direct-printing telegraph equipment;

(c) that this signal is unique for each station and may therefore be used as its identification;

(d) that the use of this signal makes unattended operation of direct-printing equipment possible;

(e) that it would be convenient if the numbers assigned in accordance with Article 25, Sections V and VI of the Radio Regulations were used in the phasing procedure;

(f) that there is a need for a conversion scheme from numerical identification to the identification signals used in the call signal,

UNANIMOUSLY RECOMMENDS

1. that, in direct-printing telegraphy systems, the call signals described in Recommendations 476 and 625 may be used as identification of a radio station;

2. that the conversion from the numerical identification to the idetification signals used in the call signal should be performed according to the Tables in Annexes I and II.

ANNEX I

TRANSLATION BETWEEN A 5- OR 4-DIGIT IDENTITY NUMBER AND A 4-SIGNAL IDENTITY

To translate a number, proceed as follows:

For a 5-digit number let the first digit determine which vertical column in Table I to use. Translate the last four digits to four alphabetic characters as indicated for each digit in the column selected in accordance with the table of conversion as given in Table I.

For a 4-digit number Table II should be used.

Examples :

The 5-digit number 32610 is transmitted as: Q (RQ) C | X T (RQ)

The 4-digit number 1234 is transmitted as: X (RQ) Q | K M (RQ)

TABLE I

5-digit numbers										
1st digit		0	1	2	3	4	5	6	7	8	9
2nd digit	0	T	V	V	V	T	T	T	V	V	V
	1	B	X	X	X	B	B	B	X	X	X
	2	U	Q	Q	Q	U	U	U	Q	Q	Q
	3	E	K	K	K	E	E	E	K	K	K
	4	O	M	M	M	O	O	O	M	M	M
	5	I	P	P	P	I	I	I	P	P	P
	6	R	C	C	C	R	R	R	C	C	C
	7	Z	Y	Y	Y	Z	Z	Z	Y	Y	Y
	8	D	F	F	F	D	D	D	F	F	F
	9	A	S	S	S	A	A	A	S	S	S
3rd digit	0	V	T	V	V	T	V	V	T	T	V
	1	X	B	X	X	B	X	X	B	B	X
	2	Q	U	Q	Q	U	Q	Q	U	U	Q
	3	K	E	K	K	E	K	K	E	E	K
	4	M	O	M	M	O	M	M	O	O	M
	5	P	I	P	P	I	P	P	I	I	P
	6	C	R	C	C	R	C	C	R	R	C
	7	Y	Z	Y	Y	Z	Y	Y	Z	Z	Y
	8	F	D	F	F	D	F	F	D	D	F
	9	S	A	S	S	A	S	S	A	A	S
4th digit	0	V	V	T	V	V	T	V	T	V	T
	1	X	X	B	X	X	B	X	B	X	B
	2	Q	Q	U	Q	Q	U	Q	U	Q	U
	3	K	K	E	K	K	E	K	E	K	E
	4	M	M	O	M	M	O	M	O	M	O
	5	P	P	I	P	P	I	P	I	P	I
	6	C	C	R	C	C	R	C	R	C	R
	7	Y	Y	Z	Y	Y	Z	Y	Z	Y	Z
	8	F	F	D	F	F	D	F	D	F	D
	9	S	S	A	S	S	A	S	A	S	A
5th digit	0	V	V	V	T	V	V	T	V	T	T
	1	X	X	X	B	X	X	B	X	B	B
	2	Q	Q	Q	U	Q	Q	U	Q	U	U
	3	K	K	K	E	K	K	E	K	E	E
	4	M	M	M	O	M	M	O	M	O	O
	5	P	P	P	I	P	P	I	P	I	I
	6	C	C	C	R	C	C	R	C	R	R
	7	Y	Y	Y	Z	Y	Y	Z	Y	Z	Z
	8	F	F	F	D	F	F	D	F	D	D
	9	S	S	S	A	S	S	A	S	A	A

TABLE II

4-digit numbers		
1st digit	0	V
	1	X
	2	Q
	3	K
	4	M
	5	P
	6	C
	7	Y
	8	F
	9	S
2nd digit	0	V
	1	X
	2	Q
	3	K
	4	M
	5	P
	6	C
	7	Y
	8	F
	9	S
3rd digit	0	V
	1	X
	2	Q
	3	K
	4	M
	5	P
	6	C
	7	Y
	8	F
	9	S
4th digit	0	V
	1	X
	2	Q
	3	K
	4	M
	5	P
	6	C
	7	Y
	8	F
	9	S

ANNEX II

TRANSLATION BETWEEN A 9-DIGIT IDENTITY NUMBER AND A 7-SIGNAL IDENTITY

A 9-digit identity number is translated into a 7-signal identity by following the procedure described below:

Step 1 : Divide the 9-digit number by 20 resulting in an integer I 1 and a remainder R1;

Step 2 : If the resulting integer is unequal to zero, divide the integer again by 20 resulting in a new integer (I 2) and a new remainder (R2);

Step 3 : Repeat Step 2 until the resulting integer becomes zero; this will require up to seven divisions;

Step 4 : If the integer becomes zero before seven divisions have been carried out, the remainders yet to be obtained shall be set to zero (e.g. if I 4 is the first integer which is zero, then R5, R6 and R7 will all be zero);

Step 5 : Translate the remainders R1, R2, R3, R4, R5, R6 and R7, into the identificaton signals IS7, IS6, IS5, IS4, IS3, IS2 and IS1, respectively, in accordance with Table III.

A 7-signal identity is converted into a 9-digit identity number by following the procedure described below:

Step 1 : Convert IS1-IS7 to the numerical values R7-R1 respectively using Table III.

Step 2 : The 9-digit identity number is then given by the following formula:

$$\text{9-digit No.} = 20^0R1 + 20R2 + 20^2R3 + 20^3R4 + 20^4R5 + 20^5R6 + 20^6R7.$$

TABLE III

Remainder (R)	Identification signal (IS)
0	V
1	X
2	Q
3	K
4	M
5	P
6	C
7	Y
8	F
9	S
10	T
11	B
12	U
13	E
14	O
15	I
16	R
17	Z
18	D
19	A

Example:

The 9-digit number 364775427 is transmitted as:

Call block 1: P (RQ) E

Call block 2: (RQ) A R

Call block 3: D B Y

364775427 divided by 20 results in I 1 = 18238771 and R1 = 7 → IS7 = Y
18238771 divided by 20 results in I 2 = 911938 and R2 = 11 → IS6 = B
911938 divided by 20 results in I 3 = 45596 and R3 = 18 → IS5 = D
45596 divided by 20 results in I 4 = 2279 and R4 = 16 → IS4 = R
2279 divided by 20 results in I 5 = 113 and R5 = 19 → IS3 = A
113 divided by 20 results in I 6 = 5 and R6 = 13 → IS2 = E
5 divided by 20 results in I 7 = 0 and R7 = 5 → IS1 = P

RECOMMENDATION 625*

DIRECT-PRINTING TELEGRAPH EQUIPMENT EMPLOYING AUTOMATIC IDENTIFICATION IN THE MARITIME MOBILE SERVICE

(Question 5/8)

(1986)

The CCIR,

CONSIDERING

(a) the there is a requirement to interconnect ship stations or ship stations and coast stations, equipped with start-stop apparatus employing the International Telegraph Alphabet No. 2, by means of radiotelegraph circuits;

(b) that direct-printing telegraph equipment in the maritime mobile service is used for:

telex and/or telegraph service between a ship station and a subscriber of the (international) telex network;

telegraph service between a ship station and a coast station or between two ship stations;

telegraph service between a ship station and an extended station (ship owner) via a coast station;

telegraph service in a broadcast mode from a coast station, or a ship station, to one or more ship stations;

(c) that the broadcast mode cannot take advantage of an ARQ method, as a return path is not used;

(d) that for the broadcast mode a forward error-correcting (FEC) method should be used;

(e) that the period for synchronization and phasing should be as short as possible;

(f) that most of the ship stations do not readily permit the simultaneous use of radio transmitter and receiver;

(g) that a direct-printing telegraph system employing error-detecting and error-correcting methods in accordance with Recommendation 476, is in actual operation;

(h) that the increased use of direct-printing telegraph equipment has emphasized the importance of an unambiguous identification of both stations when a circuit is established or re-established;

(j) that unambiguous identification could be accomplished by the exchange of self-identification signals between the ARQ equipments at the 7-unit level;

(k) that Appendix 43 of the Radio Regulations, CCIR Recommendation 585 and CCITT Recommendations F.210 and F.120 provide for a comprehensive system of assigning maritime mobile service identities;

(l) that, in the interest of having a unique identity assigned to each ship station for distress and safety and other telecommunication purposes, the address capability should allow the use of maritime mobile service identities in accordance with the provisions of Appendix 43 of the Radio Regulations;

(m) that equipment built in accordance with Recommendation 476 cannot provide for the use of maritime mobile service identities mentioned in CONSIDERING *(k)*;

(n) that there is a need to provide for compatibility to the extent possible with equipments built in accordance with Recommendation 476; however, unambiguous identification of both stations cannot be achieved when circuits are established with equipments built in accordance with Recommendation 476,

UNANIMOUSLY RECOMMENDS

1. that for direct-printing telegraph circuits in the maritime mobile service, a 7-unit ARQ method should be employed;

2. that for the direct-printing telegraph service in the broadcast mode, a 7-unit forward acting error-correcting method, using time diversity, should be employed;

3. that equipment designed in accordance with RECOMMENDS 1 and 2 should employ automatic identification and have the characteristics given in Annex I.

* The Director, CCIR is requested to bring this Recommendation to the attention of the IMO and the CCITT.

ANNEX I

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1. General (mode A (ARQ) and mode B (FEC))

1.1 The system is a single-channel synchronous system using the 7-unit constant ratio error-detecting code as listed in § 2.2 and 2.3.

1.2 The modulation rate on the radio link is 100 Bd. The equipment clock controlling the modulation rate should have an accuracy of 30 parts in 10^6 or better.

1.3 The frequency shift on the radio link is 170 Hz. When frequency shift is effected by applying audio signals to the input of a transmitter, the centre frequency of the audio spectrum applied to the transmitter should be 1700 Hz.

1.4 The radio-frequency tolerance of the transmitter and the receiver should be in accordance with Appendix 38 of the Radio Regulations. It is desirable that the receiver employs the minimum practicable bandwidth (see also Report 585).

Note. – The receiver 6 dB bandwidth should preferably be between 270 and 340 Hz.

1.5 For direct connection to the international telex network, the line input and output signals should be in accordance with the 5-unit start-stop International Telegraph Alphabet No. 2, at a modulation rate of 50 Bd.

1.6 Equipment designed in accordance with this Recommendation is likely to contain high speed digital circuitry. Special care should be taken to avoid interference to other equipment and to minimize susceptibility to interference from other equipment or electrical lines on board ship (see also Recommendation 218).

1.7 When operating in mode A (ARQ), the called station employs a constant time interval between the end of the received signal and the start of the transmitted signal (t_E in Fig. 1, § 3.2.5). In the case of long propagation distances it is essential to have this t_E as short as practicable. However, in the case of short distances it may be desirable to introduce a longer time interval, e.g. 20-40 ms, to accommodate receiver desensitization at the calling station. This time interval can be introduced at the called station either in the ARQ equipment or in the radio equipment.

2. Conversion tables

2.1 *General*

Several kinds of "signals" are used in the system, such as:

- traffic information signals,
- service information signals (control signals, idle signals, signal repetition),
- identification signals,
- check-sum signals.

2.2 *Traffic information signals*

These signals are used during communication to convey the message information which is passed from an information sending station to one or more information receiving stations. Table I lists the traffic information signals which may be used.

TABLE I

Combination No.	Traffic information signals		International Telegraph Alphabet No. 2 Code (1)	Transmitted 7-unit signal (2)
	Letter-case	Figure-case		
1	A	–	ZZAAA	BBBYYYB
2	B	?	ZAAZZ	YBYYBBB
3	C	:	AZZZA	BYBBBYY
4	D	⊠ (3)	ZAAZA	BBYYBYB
5	E	3	ZAAAA	YBBYBYB
6	F	(4)	ZAZZA	BBYBBYY
7	G	(4)	AZAZZ	BYBYBBY
8	H	(4)	AAZAZ	BYYBYBB
9	I	8	AZZAA	BYBBYYB
10	J	(Audible signal)	ZZAZA	BBBYBYY
11	K	(	ZZZZA	YBBBBYY
12	L	)	AZAAZ	BYBYYBB
13	M	.	AAZZZ	BYYBBBY
14	N	,	AAZZA	BYYBBYB
15	O	9	AAAZZ	BYYYBBB
16	P	0	AZZAZ	BYBBYBY
17	Q	1	ZZZAZ	YBBBYBY
18	R	4	AZAZA	BYBYBYB
19	S	'	ZAZAA	BBYBYYB
20	T	5	AAAAZ	YYBYBBB
21	U	7	ZZZAA	YBBBYYB
22	V	=	AZZZZ	YYBBBBY
23	W	2	ZZAAZ	BBBYYBY
24	X	/	ZAZZZ	YBYBBBY
25	Y	6	ZAZAZ	BBYBYBY
26	Z	+	ZAAAZ	BBYYYBB
27	← (Carriage return)		AAAZA	YYYBBBB
28	≡ (Line feed)		AZAAA	YYBBYBB
29	↓ (Letter shift)		ZZZZZ	YBYBBYB
30	↑ (Figure shift)		ZZAZZ	YBBYBBY
31	Δ (Space)		AAZAA	YYBBBYB
32	▭ No information		AAAAA	YBYBYBB

(1) A represents start polarity, Z represents stop polarity (see also Recommendation 490).

(2) B represents the higher emitted frequency and Y the lower (see also Recommendation 490).

(3) The pictorial representation shown is a schematic of ✠ which may also be used when equipment allows (CCITT Rec. F.1, § C9).

(4) At present unassigned (see CCITT Rec. F.1, § C8). Reception of these signals, however, should not initiate a request for repetition.

2.3 *Service information signals*

These signals are used to control the procedures taking place over the radio circuit and do not form part of the transmitted messages. Service information signals are not normally printed or displayed. Table II lists the service information signals which may be used.

2.4 *Identification and check-sum numbers and signals*

Identification and check-sum numbers and signals are used in the automatic identification procedure in order to provide a means by which, during the establishment or re-establishment of a radio circuit, the stations concerned are clearly and unambiguously identified to each other. The relationship between the transmitted identification signals and their equivalent numbers is shown in Table IIIa; Table IIIb indicates the conversion from check-sum numbers to the transmitted check-sum signals.

TABLE II

Mode A (ARQ)	Transmitted signal	Mode B (FEC)
Control signal 1 (CS1)	BYBYYBB	
Control signal 2 (CS2)	YBYBYBB	
Control signal 3 (CS3)	BYYBBYB	
Control signal 4 (CS4)	BYBYBBY	
Control signal 5 (CS5)	BYYBYBB	
Idle signal β	BBYYBBY	Idle signal β
Idle signal α	BBBBYYY	Phasing signal 1, Idle signal α
Signal repetition (RQ)	YBBYYBB	Phasing signal 2

TABLE IIIa

Identification signal (IS)	Equivalent number (N)
A	19
B	11
C	6
D	18
E	13
F	8
I	15
K	3
M	4
O	14
P	5
Q	2
R	16
S	9
T	10
U	12
V	0
X	1
Y	7
Z	17

TABLE IIIb

Check-sum number (CN)	Check-sum signal (CK)
0	V
1	X
2	Q
3	K
4	M
5	P
6	C
7	Y
8	F
9	S
10	T
11	B
12	U
13	E
14	O
15	I
16	R
17	Z
18	D
19	A

2.5 *Check-sum signal derivation*

These identification signals IS1, IS2, IS3, IS4, IS5, IS6 and IS7 are converted into their equivalent numbers N1, N2, N3, N4, N5, N6 and N7 respectively, in accordance with Table IIIa. The three numbers N1, N2 and N3 are added and the sum is translated into one check-sum number CN1 using modulo 20-addition. This process is repeated for the numbers N3, N4 and N5 resulting in a check-sum number CN2 and for the numbers N5, N6 and N7 resulting in a check-sum number CN3, as follows:

$$N1 \oplus N2 \oplus N3 = CN1$$
$$N3 \oplus N4 \oplus N5 = CN2$$
$$N5 \oplus N6 \oplus N7 = CN3$$

where $\oplus$ denotes modulo 20-addition.

The last conversion is from check-sum numbers CN1, CN2 and CN3 into "check-sum signal 1", "check-sum signal 2" and "check-sum signal 3" respectively, in accordance with Table IIIb.

Example

The seven identfication signals of station 364775427 are: P E A R D B Y (see Recommendation 491).

The check-sum derivation will be as follows:

P E A R D B Y → 5 13 19 16 18 11 7

5 ⊕ 13 ⊕ 19 = 17 (37-20)
19 ⊕ 16 ⊕ 18 = 13 (53-20-20)
18 ⊕ 11 ⊕ 7 = 16 (36-20)

17 13 16 → Z E R

where ⊕ denotes modulo 20-addition.

Result:

CK1 becomes "Z" (combination No. 26, see Table I)
CK2 becomes "E" (combination No. 5, see Table I)
CK3 becomes "R" (combination No. 18, see Table I)

3. Characteristics, mode A (ARQ)

3.1 *General*

The system operates in a synchronous mode transmitting blocks of three signals from an information sending station (ISS) towards an information receiving station (IRS). A control signal is transmitted from the IRS to the ISS after reception of each block indicating correct reception or requesting retransmission of the block. These stations can interchange their functions.

3.2 *Master and slave arrangements*

3.2.1 The station that initiates the establishment of the radio circuit (the calling station) becomes the "master" station, and the station being called will be the "slave" station. This situation remains unchanged during the entire time that the established radio circuit is maintained, regardless of which station, at any given time, is the information sending station (ISS) or the information receiving station (IRS).

3.2.2 The clock in the master station controls the timing of the entire circuit (see circuit timing diagram, Fig. 1). This clock should have an accuracy of 30 parts in 10^6 or better.

3.2.3 The basic timing cycle is 450 ms and consists for each station of a transmission period followed by a transmission pause during which reception is effected.

3.2.4 The master station transmit timing is controlled by the clock in the master station.

3.2.5 The clock controlling the timing of the slave station is phase-locked to the signal received from the master station, i.e. the time interval between the end of the received signal and the start of the transmitted signal (t_E in Fig. 1) is constant (see also § 1.7).

3.2.6 The master station receive timing is phase-locked to the signal received from the slave station.

3.3 *The information sending station (ISS)*

3.3.1 The ISS groups the information to be transmitted into blocks of three signals (3 × 7 signal elements).

3.3.2 The ISS sends a block in 210 ms (3 × 70 ms) after which a transmission pause of 240 ms becomes effective.

3.4 *The information receiving station (IRS)*

3.4.1 After the reception of each block the IRS sends one signal of 70 ms duration (7-signal elements), after which a transmission pause of 380 ms becomes effective.

3.5 *Phasing procedure*

3.5.1 When no circuit is established, both stations are in the "stand-by" condition. In this condition neither of the stations is designated master, slave, ISS or IRS.

3.5.2 The "call signal" contains either four or seven identification signals as applicable. The identification signals are listed in Table IIIa. The composition of these "call signals" should be in accordance with Recommendation 491.

3.5.2.1 The equipment should be capable of operating with both 4-signal and 7-signal identity procedures and automatically employing the appropriate procedure for either, as indicated by the composition of the "call signal" received from a calling station or by the number of digits (4, 5 or 9) supplied to the equipment of a calling station to identify the station to be called.

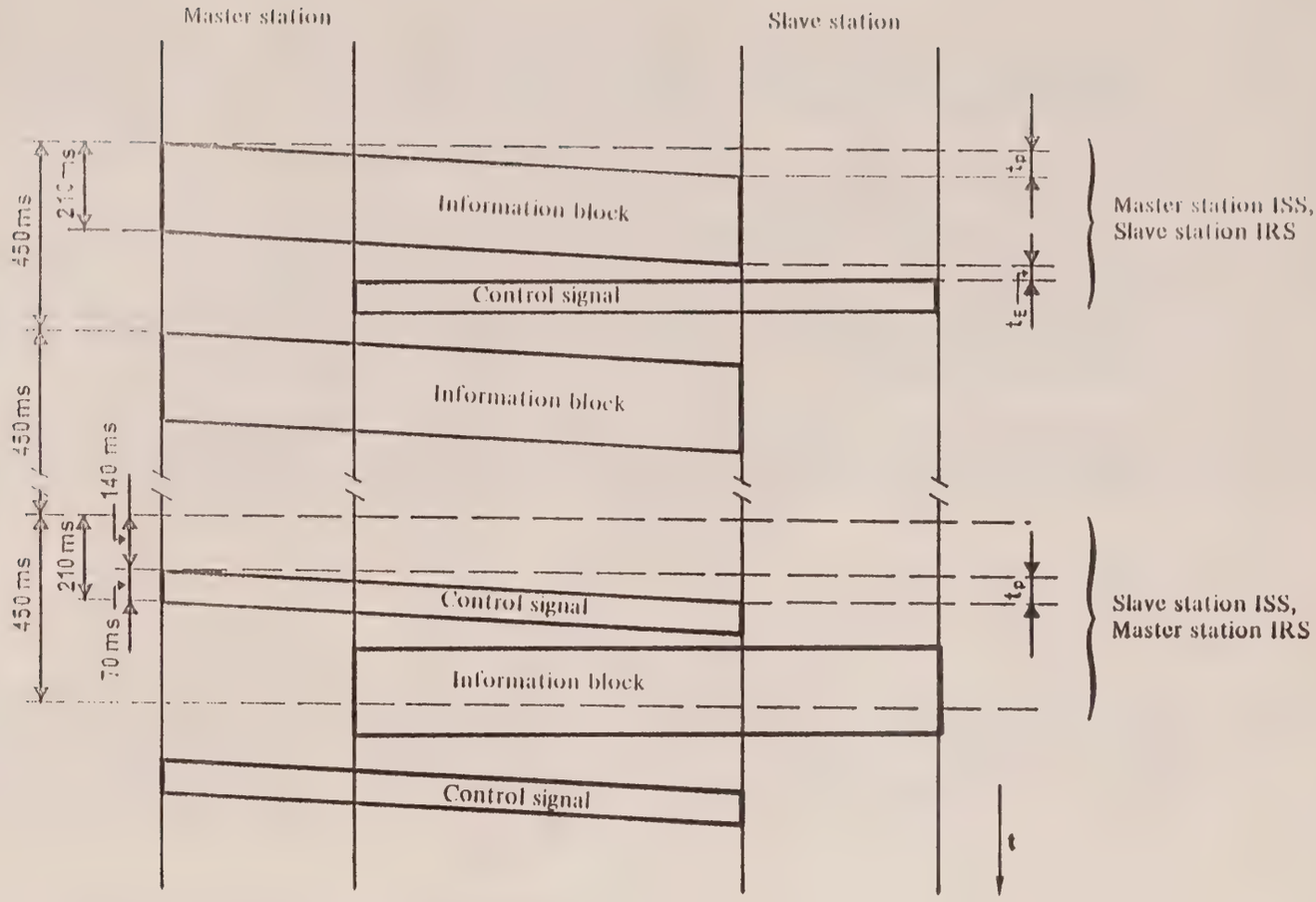


FIGURE 1 – *Basic timing diagram*

t_p : (one-way) propagation time

t_E : equipment delay (see also § 1.7)

3.5.3 The "call signal" contains:

- in "call block 1": in the first, second and third character places respectively: the first identification signal, the service information signal "signal repetition" and the second identification signal of the called station;
- in "call block 2": in the first, second and third character places respectively, either:
  - in the case of a 4-signal call identity: the third and the fourth identification signals of the called station and "signal repetition"; or
  - in the case of a 7-signal call identity: "signal repetition", and the third and fourth identification signals of the called station;
- in the case of a 7-signal call identity in "call block 3": the last three identification signals of the called station.

3.5.4 The station required to establish the circuit becomes the master station and sends the "call signal" until it receives an appropriate control signal; however, if the circuit has not been established within 128 cycles (128 × 450 ms), the station changes into the "stand-by" condition and waits for a time of at least 128 cycles before sending the same "call signal" again.

3.5.5 The called station becomes the slave station and changes from the "stand-by" to the IRS condition:

- in the case of a 4-signal call identity following the consecutive reception of "call block 1" and "call block 2", after which it sends "control signal 1" until the first information block has been received;
- in the case of a 7-signal call identity following the reception of the three call blocks in succession after which it sends "control signal 4" until "identification block 1" has been received.

3.5.6 On receipt of two consecutive identical signals "control signal 1" or "control signal 2" the calling station changes to the ISS condition and proceeds directly with the transmission of traffic information (see § 3.7) without automatic identification.

Note. Equipment built in accordance with Recommendation 476 sends "control signal 1" or "control signal 2" on receipt of the appropriate "call signal".

3.5.7 On receipt of "control signal 3" during the phasing procedure, the calling station immediately changes to the "stand-by" condition, and waits 128 cycles before sending the same "call signal" again.

Note. Equipment built in accordance with Recommendation 476 may send "control signal 3" on receipt of the appropriate "call signal", if the called station is rephasing and was in the ISS condition at the moment of interruption.

3.5.8 On receipt of "control signal 5" during the phasing procedure, the calling station starts the "end-of-communication" procedure in accordance with § 3.7.14, and waits at least 128 cycles before sending the same "call signal" again. During this waiting time the station is in the "stand-by" condition.

3.6 *Automatic identification*

Only applicable in the case of a 7-signal call identity.

3.6.1 On receipt of "control signal 4" the calling station changes to the ISS condition and starts the identification procedure. During the identification cycle, information is exchanged about the identities of both stations; the ISS transmits its identification blocks and the IRS returns the check-sum signals derived from its identity in accordance with § 2.5. On receipt of each check-sum signal, the calling station compares this signal with the appropriate check-sum signal locally derived from the identification signals transmitted in the call blocks. If they are identical, the calling station continues with the following procedure, otherwise the procedure of § 3.6.12 is followed.

3.6.2 The ISS sends "identification block 1" containing its own first identification signal, "idle signal α" and its second identification signal in the first, second and third character places respectively.

3.6.3 On receipt of "identification block 1" the called station sends "check-sum signal 1", derived from its identity.

3.6.4 On receipt of "check-sum signal 1" the calling station sends "identification block 2" containing the first, second and third character places respectively, "idle signal α", its third identification signal and its fourth identification signal.

3.6.5 On receipt of "identification block 2" the called station sends "check-sum signal 2", derived from its identity.

3.6.6 On receipt of "check-sum signal 2" the calling station sends "identification block 3" containing its fifth, sixth and seventh identification signals in the first, second and third character places respectively.

3.6.7 On receipt of "identification block 3" the called station sends "check-sum signal 3", derived from its identity.

3.6.8 On receipt of the last check-sum signal the calling station sends the "end -of-identification block" containing three "signal repetition" signals.

3.6.9 On receipt of the "end-of-identification block" the called station sends, either:

- "control signal 1", thus starting the traffic flow in accordance with § 3.7; or
- "control signal 3", if the called station is required to start the traffic flow in the ISS condition (in accordance with § 3.7.11).

3.6.10 On receipt of "control signal 1" the calling station ends the identification cycle and starts the traffic flow by transmitting "information block 1" in accordance with § 3.7.

3.6.11 On receipt of "control signal 3" the calling station ends the identification cycle and starts the traffic flow with the change-over procedure in accordance with § 3.7.11.

3.6.12 If any received check-sum signal is not identical to the locally derived check-sum signal, the calling station retransmits the previous identification block. On receipt of this identification block, the called station sends the appropriate check-sum signal once more.

On receipt of this check-sum signal the calling station compares again. If they are still not identical, and the received check-sum signal is the same as the previous one, the calling station initiates the "end of communication" procedure in accordance with § 3.7.14; otherwise the calling station transmits the previous identification block again. Any identification block should not be retransmitted more than four times due to reception of wrong check-sum signals, after which, if the required check-sum signal is still not received, the calling station reverts to the "stand-by" condition.

3.6.13 If, due to mutilated reception, the calling station does not receive:

"control signal 4", it continues transmitting the "call signal";

"check-sum signal 1", it retransmits "identification block 1";

"check-sum signal 2", it retransmits "identification block 2";

"check sum signal 3", it retransmits "identification block 3";

"control signal 1" or "control signal 3", it retransmits the "end-of-identification block",

taking into account the time limit mentioned in § 3.6.18.

3.6.14 If, due to mutilated reception, the called station does not receive a block during the identification cycle, it transmits a "signal repetition", taking into account the time limit mentioned in § 3.6.18.

3.6.15 If during the identification cycle the calling station receives a "signal repetition", it retransmits the previous block.

3.6.16 If, due to retransmission of an identification block by the calling station, the identification signals as received by the called station are not identical, the called station sends "signal repetition" until two identical consecutive identification blocks are received after which the corresponding check-sum signal is transmitted, taking into account the time limit mentioned in § 3.6.18.

3.6.17 If during the identification cycle the called station receives the "end-of-communication block" (containing three "idle signals α"), it sends a "control signal 1" and reverts to the "stand-by" condition.

3.6.18 When reception of signals during the identification cycle is continuously mutilated, both stations revert to the "stand-by" condition after 32 cycles of continuous repetition.

3.6.19 Each station should retain the identity of the other station for the duration of the connection (see § 3.7.1) and this information should be accessible locally, e.g. by means of a display or on a separate output circuit for external use. However, this identity information should not appear on the output line to the network.

3.7 *Traffic flow*

3.7.1 At all times after the start of the traffic flow and until the station reverts to the "stand-by" condition, the station should retain the following information:

- whether it is in the master or slave condition;
- the identity of the other station (when applicable);
- whether it is in the ISS or IRS condition;
- whether the traffic flow is in the letter case or figure case condition.

3.7.2 The ISS transmits the traffic information in blocks, each block consisting of three signals. If necessary, "idle signals β" are used to complete or to fill information blocks when no traffic information is available.

3.7.3 The ISS retains the transmitted information block in memory until the appropriate control signal confirming correct reception by the IRS has been received.

3.7.4 For internal use, the IRS numbers the received information blocks alternately "information block 1" and "information block 2" dependent on the first transmitted control signal. The numbering is interrupted at the reception of, either:

- an information block in which one or more signals are mutilated; or
- an information block containing at least one "signal repetition".

3.7.5 The IRS sends "control signal 1" at the reception of, either:

- an unmutilated "information block 2"; or
- a mutilated "information block 1"; or
- an "information block 1" containing at least one "signal repetition".

3.7.6 The IRS sends "control signal 2" at the reception of, either:

- an unmutilated "information block 1"; or
- a mutilated "information block 2"; or
- an "information block 2" containing at least one "signal repetition".

3.7.7 For internal use, the ISS numbers successive information blocks alternately "information block 1" and "information block 2". The first block should be numbered "information block 1" or "information block 2" dependent on whether the received control signal is a "control signal 1" or a "control signal 2". The numbering is interrupted at the reception of, either:

- a request for repetition; or
- a mutilated control signal; or
- a "control signal 3".

3.7.8 On receipt of "control signal 1" the ISS sends "information block 1".

3.7.9 On receipt of "control signal 2" the ISS sends "information block 2".

3.7.10 On receipt of a mutilated control signal the ISS sends a block containing three "signal repetitions".

3.7.11 *Change-over procedure*

3.7.11.1 If the ISS is required to initiate a change in the direction of the traffic flow, the station sends the signal sequence ("↑" combination No. 30), "+" (combination No. 26), "?" (combination No. 2)) followed, if necessary, by one or more "idle signals β" to complete the information block.

3.7.11.2 On receipt of the signal sequence ("+", "?" (combination No. 26 and combination No. 2)) with the traffic flow in the figure case condition, the IRS sends "control signal 3" until an information block containing the signals "idle signal β", "idle signal α", idle signal β" has been received.

Note. – The presence of "idle signals β" between the signals "+" and "?" should not inhibit the response of the IRS.

3.7.11.3 If the IRS is required to initiate a change in the direction of the traffic flow, it sends "control signal 3".

3.7.11.4 On receipt of "control signal 3" the ISS sends an information block containing "idle signal β", idle signal α" and "idle signal β" in the first, second and third character places respectively.

3.7.11.5 On receipt of the information block containing the service information signals "idle signal β", "idle signal α" and "idle signal β", the IRS changes to ISS and sends, either:

an information block containing three "signal repetitions", if it is the slave station; or

one "signal repetition", if it is the master station,

until either "control signal 1" or "control signal 2" is received, taking into account the time limit mentioned in § 3.7.12.1.

3.7.11.6 The ISS changes to IRS after the reception of, either:

an information block containing three "signal repetitions" if it is the master station; or

– one "signal repetition" if it is the slave station,

and sends either "control signal 1" or "control signal 2" depending on whether the preceding control signal was "control signal 2" or "control signal 1", respectively, after which the traffic flow starts in the appropriate direction.

3.7.12 *Time-out procedure*

3.7.12.1 When reception of information blocks or of control signals is continuously mutilated, both stations revert to the "rephase" condition after 32 cycles of continuous repetition, in accordance with § 3.8.

3.7.13. *Answer-back procedure*

3.7.13.1 If the ISS is required to request terminal identification, the station sends the signals "↑" (combination No. 30) and "☒" (combination No. 4) followed, if necessary, by one or more "idle signals β" to complete the information block.

3.7.13.2 On receipt of an information block containing the traffic information signal "☒" (combination No. 4) with the traffic flow in the figure case condition, the IRS:

– changes the direction of the traffic flow in accordance with § 3.7.11;

– transmits the traffic information signals derived from the teleprinter answer-back code generator;

– transmits, after completion of the answer-back code, or in the absence of an answer-back code, two information blocks of three "idle signals β";

– changes the direction of the traffic flow in accordance with § 3.7.11, and reverts to IRS.

3.7.14 *End-of-communication procedure*

3.7.14.1 If the ISS is required to terminate the established circuit, it sends the "end-of-communication block" containing three "idle signals α", until the appropriate "control signal 1" or "control signal 2" has been received; however, the number of transmissions of the "end-of-communication block" is limited to four, after which the ISS reverts to the "stand-by" condition.

3.7.14.2 On receipt of the "end-of-communication block" the IRS sends the appropriate control signal indicating correct reception of this block, and reverts to the "stand-by" condition.

3.7.14.3 On receipt of the control signal that confirms the unmutilated reception of the "end-of-communication block", the ISS reverts to the "stand-by" condition.

3.7.14.4 If the IRS is required to terminate the established circuit, it has first to change over to the ISS condition, in accordance with § 3.7.11, before the termination can take place.

3.8 *Rephasing procedure*

3.8.1 If during the traffic flow, reception of information blocks or control signals is continuously mutilated, both stations change to the "rephase" condition after 32 cycles of continuous repetition. Rephasing is the automatic re-establishment of the previous circuit immediately following interruption of that circuit as a result of continuous repetition (see § 3.7.12).

Note. – Some coast stations do not provide for rephasing. Therefore, it should be possible to disable the rephasing procedure.

3.8.2 After changing to the "rephase" condition the master station immediately initiates the rephasing procedure. This procedure is the same as the phasing procedure; however, in the case of a 7-signal call identity, instead of "control signal 4" the rephasing slave station will transmit "control signal 5" after the reception of the appropriate "call signal" transmitted by the rephasing master station.

3.8.3 When "control signal 5" is received by the master station, automatic identification takes place along the same lines as laid down in § 3.6. However, on receipt of the "end-of-identification block", containing three "signal repetitions":

3.8.3.1 If, at the time of interruption, the slave station was in the IRS condition, it sends either:

– "control signal 1" if the last correctly received block before the interruption occured as an "information block 2"; or

"control signal 2" if the last correctly received block before the interruption occured was an "information block 1".

3.8.3.2 If, at the time of interruption, the slave station was in the ISS condition, it sends "control signal 3", to initiate change-over to the IRS condition. When the change-over is completed, i.e. after correct reception of the block containing three "signal repetitions" by the master station, the master station sends either:

– "control signal 1" if the last correctly received block before the interruption occurred was an "information block 2"; or

"control signal 2" if the last correctly received block before the interruption occurred was an "information block 1".

3.8.4 On receipt of "control signal 4", during the rephasing procedure the master station sends one "end-of-communication block" containing three "idle signals α" after which it continues with the rephasing attempt.

3.8.5 On receipt of each identification block, the slave station compares the received identification signals with the previously stored identity of the master station and:

– if the signals are identical, the slave station continues with the procedure by sending the appropriate check-sum signal;
– if the signals are not identical, the slave station initiates the "end-of-communication" procedure in accordance with § 3.7.14 and remains in the "rephase" condition.

3.8.6 On receipt of a block containing three "idle signals α", the slave station sends one "control signal 1" and remains in the "rephase" condition.

3.8.7 In the case of a 4-signal call identity, the rephasing master station:

– upon receipt of two consecutive signals "control signal 1" or "control signal 2" resumes directly with the transmission of traffic information if the slave station was in the IRS condition, or initiates the change-over procedure in accordance with § 3.7.11.1 if the slave station was in the ISS condition;

– upon receipt of two consecutive signals "control signal 3" proceeds directly with the change-over procedure in accordance with § 3.7.11.4 if the slave station was in the ISS condition.

3.8.8 In the case of a 4-signal call identity, the slave station on receipt of the appropriate "call signal" sends:

– if, at the time of interruption, the slave station was in the IRS condition, either:

  – "control signal 1" if it had correctly received "information block 2" before the interruption occurred; or

  – "control signal 2" if it had correctly received "information block 1" before the interruption occurred;

– if, at the time of interruption, the slave station was in the ISS condition, "control signal 3" to initiate change-over to the ISS condition.

3.8.9 If rephasing has not been accomplished within the time-out interval of 32 cycles, both stations revert to the "stand-by" condition and no further rephasing attempts are made.

3.9 *Summary of service blocks and service information signals*

3.9.1 *Service blocks*

X_1 - RQ - X_2 : "Call block 1" containing the 1st and 2nd identification signals.

X_3 - X_4 - RQ : "Call block 2" for a 4-signal call identity containing the 3rd and 4th identification signals.

RQ - X_3 - X_4 : "Call block 2" for a 7-signal call identity containing the 3rd and 4th identification signals.

X_5 - X_6 - X_7 : "Call block 3" for a 7-signal call identity containing the 5th, 6th and 7th identification signals.

Y_1 - α - Y_2 : "Identification block 1" containing self-identification signals 1 and 2 and request for the 1st check-sum signal.

α - Y_3 - Y_4 : "Identification block 2" containing self-identification signals 3 and 4 and request for the 2nd check-sum signal.

Y_5 - Y_6 - Y_7 : "Identification block 3" containing self-identification signals 5, 6 and 7 and request for the 3rd check-sum signal.

RQ - RQ - RQ : If occurring within the automatic identification procedure, indicates the end of that procedure and requests the appropriate control signal.

During the traffic flow, indicates request for repetition of the last control signal or in the change-over procedure response to β-α-β.

β - α - β : Block to change the direction of the traffic flow.

α - α - α : Block to initiate the end-of-communication procedure.

3.9.2 *Service information signals*

CS1 : Request for "information block 1" or "call signal" has been correctly received during phasing/rephasing (only in the case of a 4-signal call identity).

CS2 : Request for "information block 2".

CS3 : IRS requests change of traffic flow direction.

CS4 : "Call signal" has been correctly received during phasing.

CS5 : "Call signal" has been correctly received during rephasing.

RQ : Request for retransmission of the last identification or information block or in the change-over procedure, response to β-α-β.

4. Characteristics, mode B (FEC)

4.1 *General*

The system operates in a synchronous mode, transmitting an uninterrupted stream of signals from a station sending in the collective B-mode (CBSS) to a number of station receving in the collective B-mode (CBRS), or from a station sending in the selective B-mode (SBSS) to one or more selected stations receiving in the selective B-mode (SBRS).

4.2 *The sending station (CBSS and SBSS)*

The sending station, both in collective and in selective B-mode, sends each signal twice: the first transmission (DX) of a specific signal is followed by the transmission of four other signals, after which the retransmission (RX) of the first signal takes place, allowing for time-diversity reception at 280 ms (4 × 70 ms) time space (see Fig. 2).

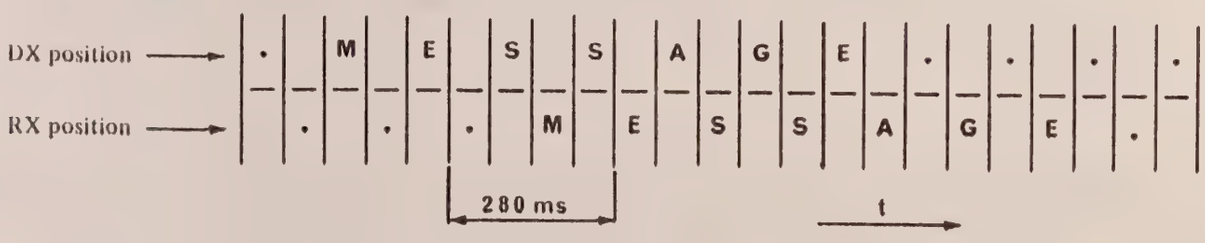


FIGURE 2 – *Time-diversity transmission*

4.3 *The receiving station*

The receiving station, both in collective and selective B-mode, checks both signals (DX and RX), and uses the unmutilated one. When both signals appear as unmutilated but different, then both signals should be considered as mutilated.

4.4 *Phasing procedure*

4.4.1 When no circuit is established, both stations are in the "stand-by" condition and no sending or receiving condition is assigned to either of the stations.

4.4.2 The station required to transmit information becomes the sending station and sends alternately "phasing signal 2" and "phasing signal 1", whereby "phasing signal 2" is transmitted in the DX position and "phasing signal 1" in the RX position. At least sixteen of these signal pairs should be transmitted.

4.4.3 On receipt of the signal sequence "phasing signal 1"-"phasing signal 2", or of the signal sequence "phasing signal 2"-"phasing signal 1", in which "phasing signal 2" determines the DX position and "phasing signal 1" determines the RX position, and at least two further phasing signals in the appropriate position, the station changes to the CBRS condition and offers continuous stop-polarity to the line output terminal until either the traffic information signal "←" (combination No. 27) or "≡" (combination No. 28) is received.

4.5 *Selecting calling procedure (selective B-mode)*

4.5.1 After the transmission of the required number of phasing signals, the SBSS sends the "call signal", which consists of six transmissions of a sequence, each consisting of the identification signals of the station to be selected followed by an "idle signal β". This transmission takes place using time-diversity in accordance with § 4.2.

4.5.2 The SBSS sends the "call signal" and all further information signals in a 3B/4Y ratio, i.e. inverted with respect to the information signals in Tables I and II and the identification signals in Table IIIa.

4.5.3 The "call signal" contains either four, or seven identification signals as applicable. The identification signals are listed in Table IIIa. The composition of these "call signals" should be in accordance with Recommendation 491.

4.5.4 Following unmutilated reception of one complete signal sequence representing its inverted identification signals, the CBRS changes to the SBRS condition and continues offering stop-polarity to the line output terminal until either the traffic information signal; "←" (combination No. 27) or "≡" (combination No. 28) is received.

4.5.5 The station in the SBRS condition accepts the subsequent information signals received with the 3B/4Y ratio, all other stations reverting to the "stand-by" condition.

4.6 *Traffic flow*

4.6.1 Immediately prior to the transmission of the first traffic signals the sending station transmits the information signals "←" (combination No. 27) and "≡" (combination No. 28), and starts transmitting traffic.

4.6.2 A CBSS sends, during breaks in the information flow, "phasing signals 1" and "phasing signals 2" in the RX and DX positions respectively. At least one sequence of four consecutive phasing signal pairs should occur for every 100 signals sent in the DX position during traffic flow.

4.6.3 A SBSS sends, during breaks in the information flow, "idle signals β".

4.6.4 On receipt of either the traffic combination signal "←" (combination No. 27) or "≡" (combination No. 28), the receiving station starts printing the received traffic information signals.

Note. – The term "printing" is used in § 4.6.4 and 4.6.5 to denote the transfer of traffic signals to the output device.

4.6.5 The receiving station checks both signals received in the DX and RX position:

- printing an unmutilated DX or RX signal; or
- printing a "Δ" (combination No. 31), or alternatively an "error character" (to be user-defined) if both DX and RX signals are mutilated or appear unmutilated but are different.

4.6.6 A receiving station reverts to the "stand-by" condition if, during a predetermined time, the percentage of mutilated signals received has reached a predetermined value.

4.6.7 *End-of-transmission*

4.6.7.1 A station sending in the B-mode (CBSS or SBSS) should terminate the transmission by sending at least 2 s of consecutive "idle signals α", immediately after the last transmitted traffic information signals after which the station reverts to the "stand-by" condition.

4.6.7.2 The receiving station reverts to the "stand-by" condition not less than 210 ms after receipt of at least two consecutive "idle signals α" in the DX position.

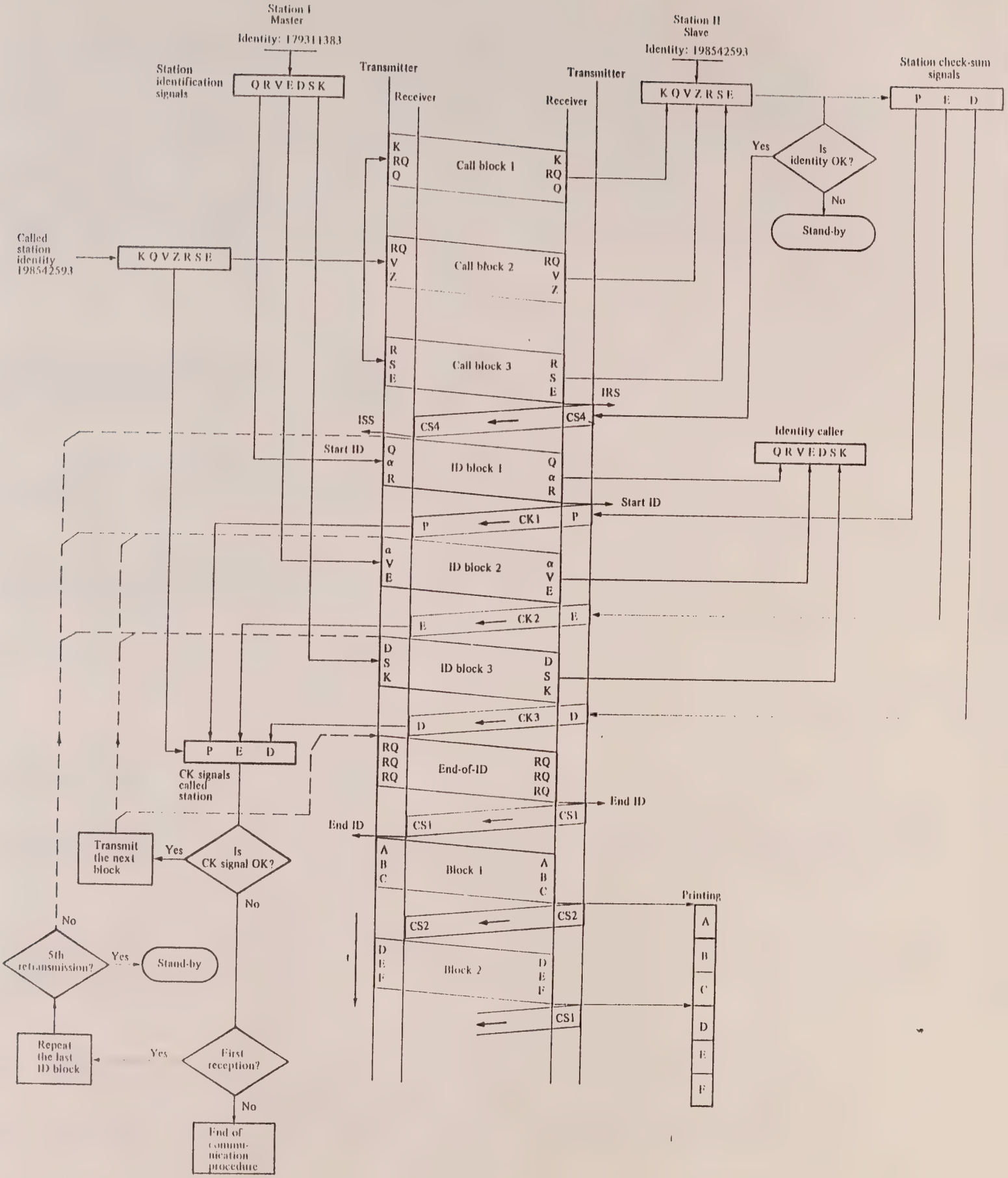


FIGURE 3 – *Phasing procedure with automatic identification in the case of a 7-signal call identity (mode A)*

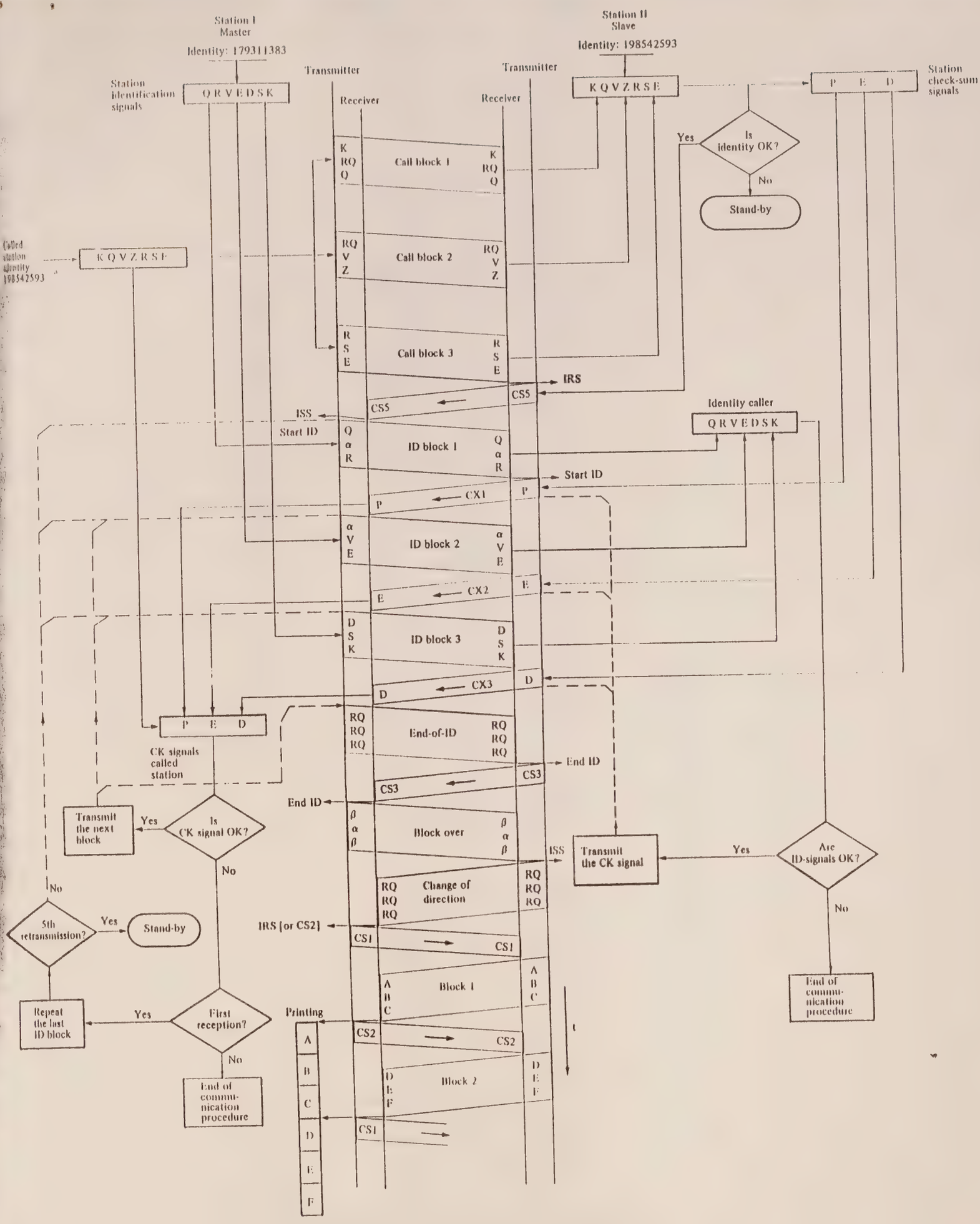


FIGURE 4 *Rephasing procedure with automatic identification in the case of a 7-signal call identity (station II was ISS)*

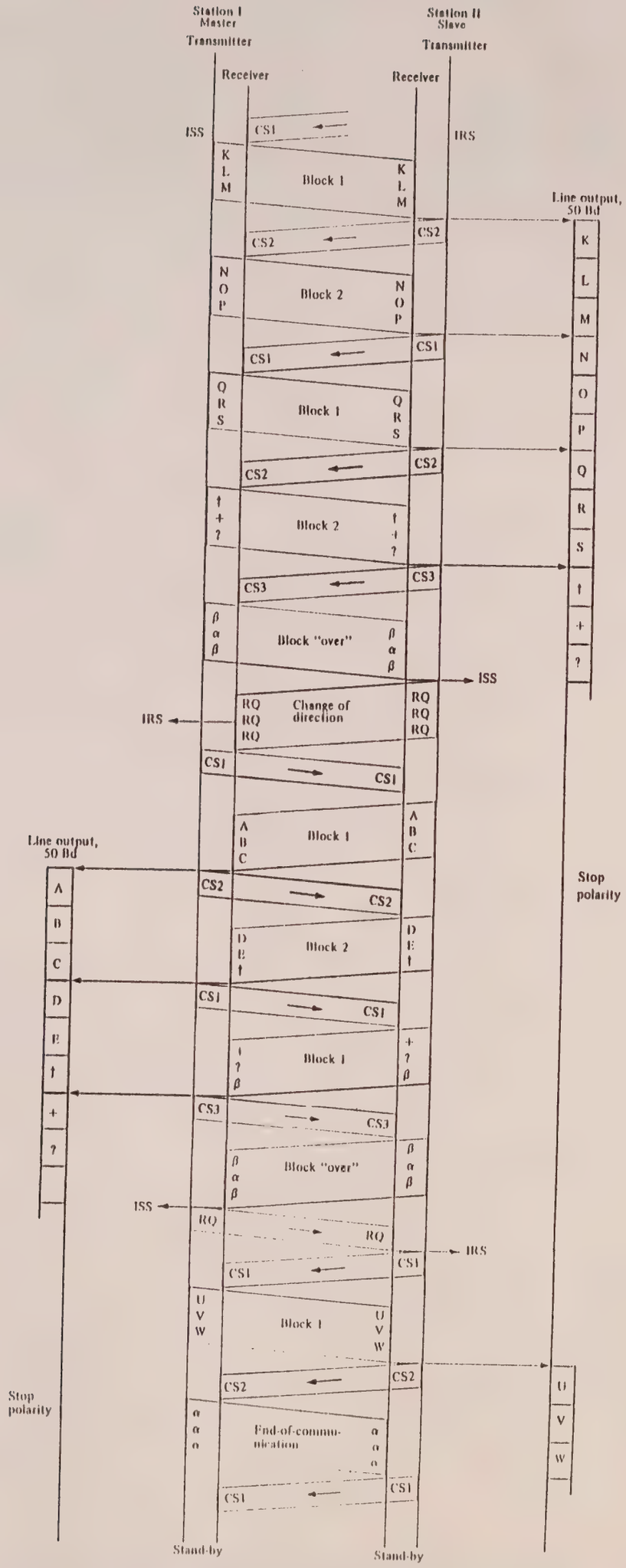


FIGURE 5 – *Traffic flow with change-over procedure and end-of-communication*

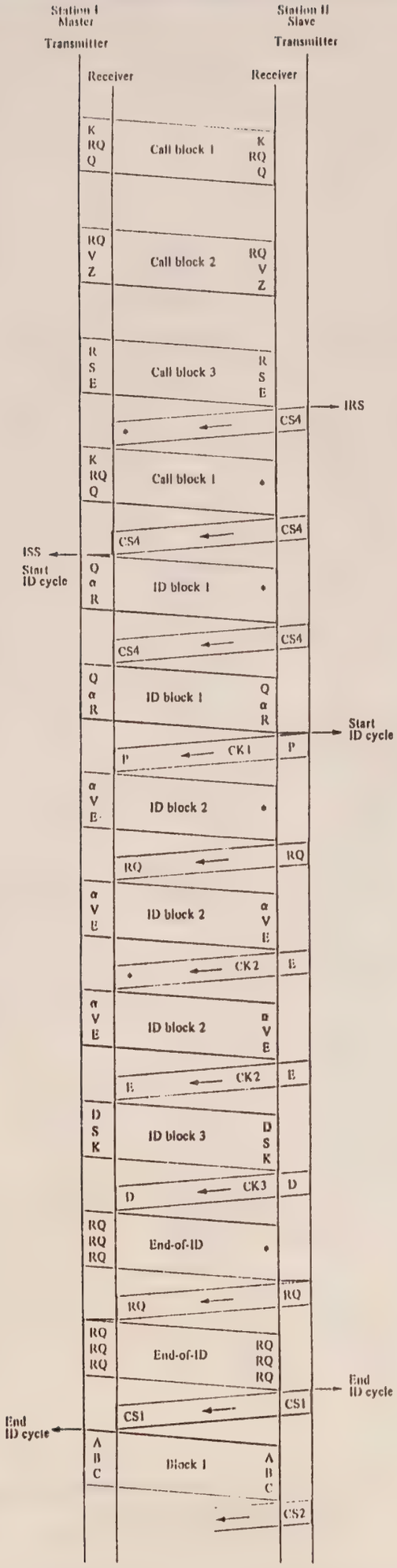


FIGURE 6 -- *Phasing procedure with automatic identification in the condition of mutilated reception in the case of a 7-signal call identity*

* detected error

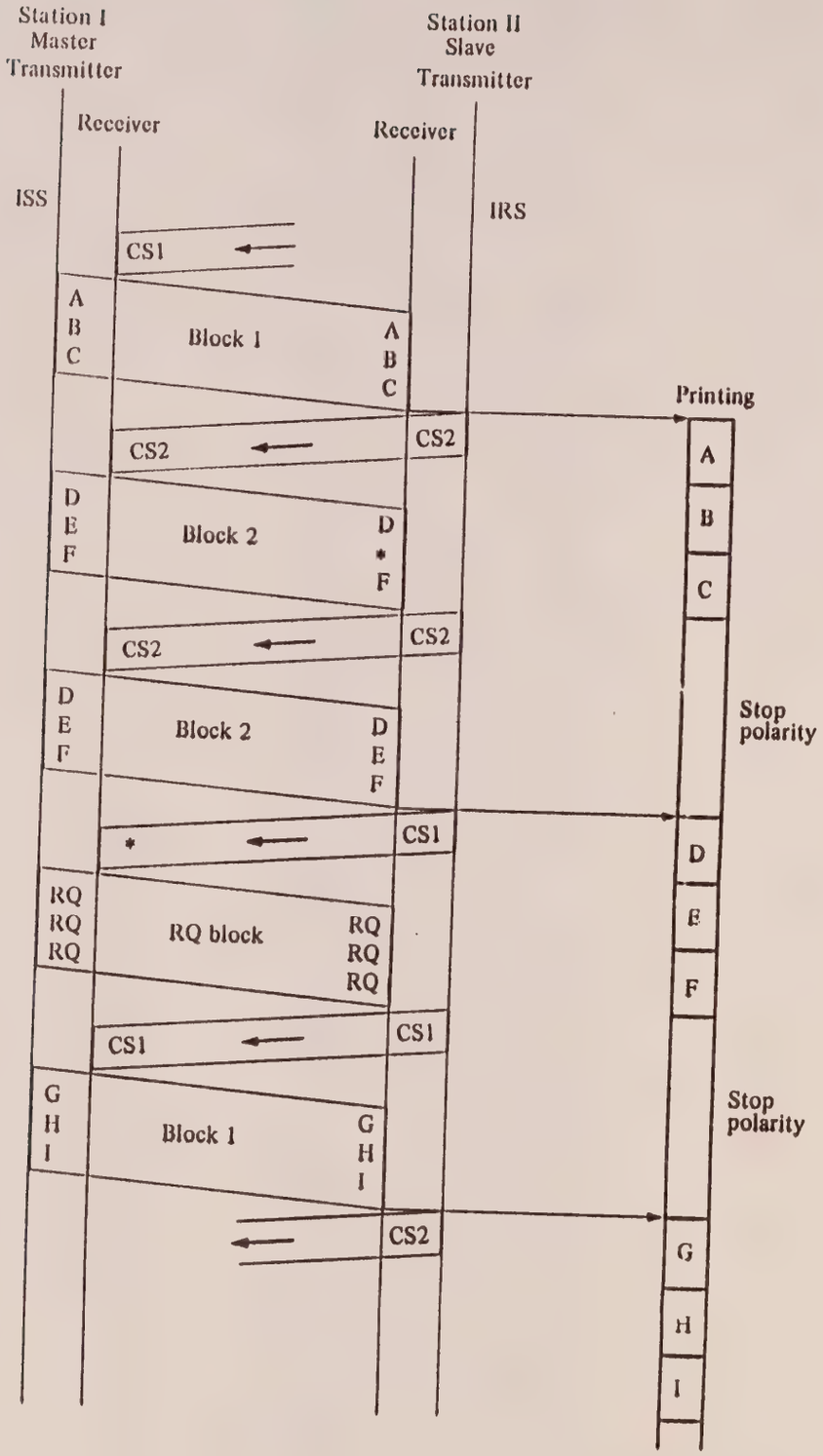


FIGURE 7 – *Traffic flow in the condition of mutilated reception*

* Detected error

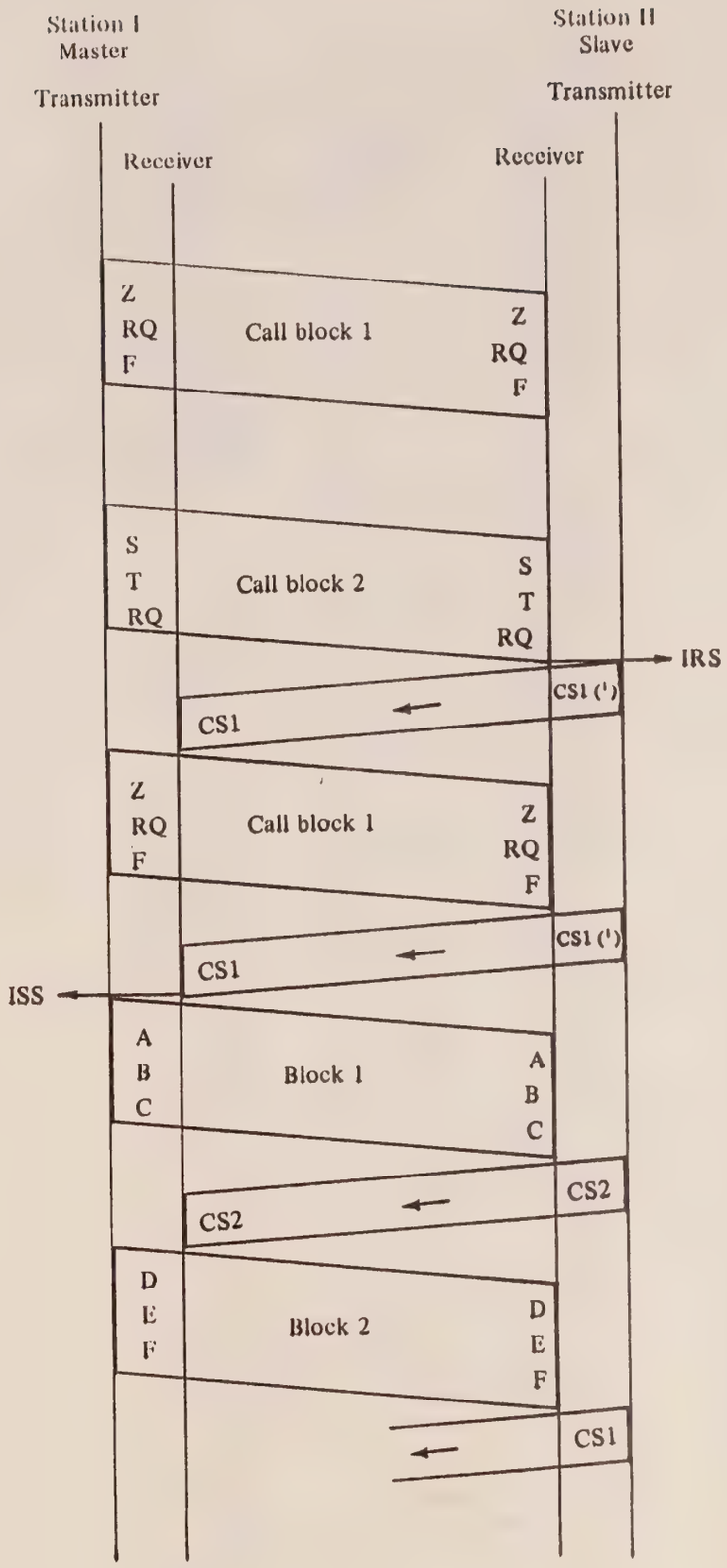


FIGURE 8 – *Phasing procedure in the case of a 4-signal call identity*

(1) With some equipment built in accordance with Recommendation 476 this could be CS2.

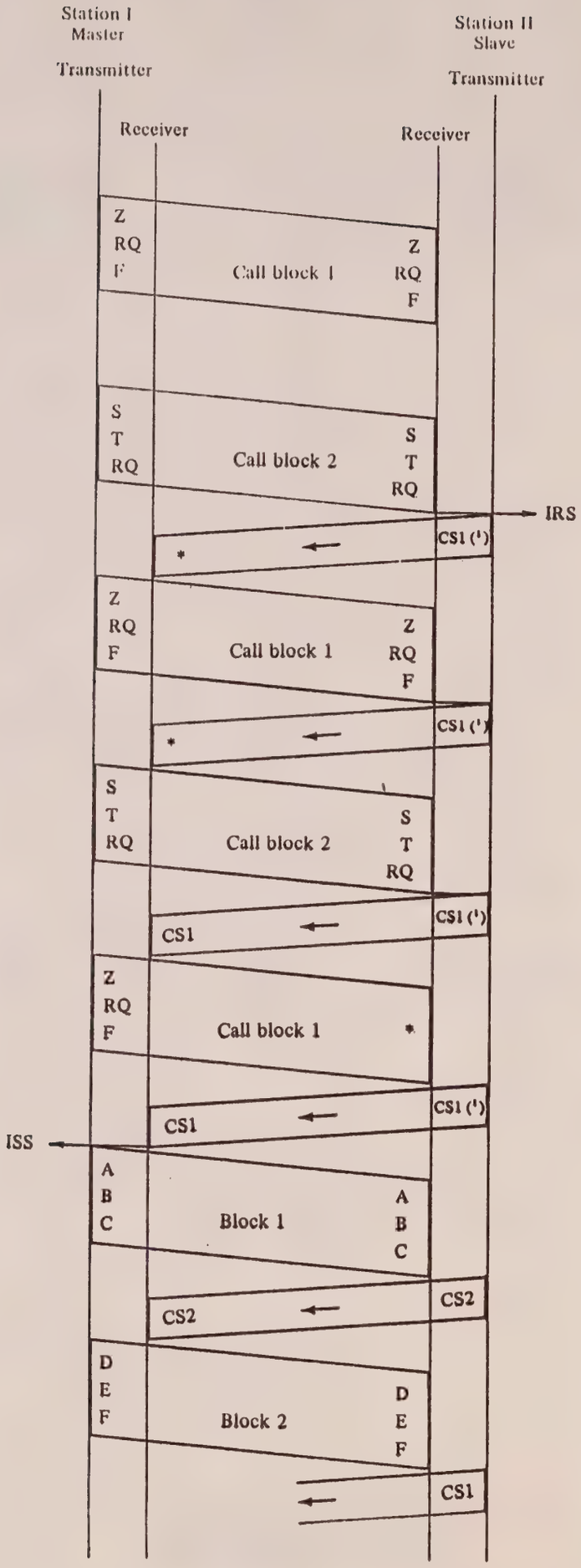


FIGURE 9 – *Phasing procedure in the condition of mutilated reception in the case of a 4-signal call identity*

* Detected error

(1) With some equipment built in accordance with Recommendation 476 this could be CS2.

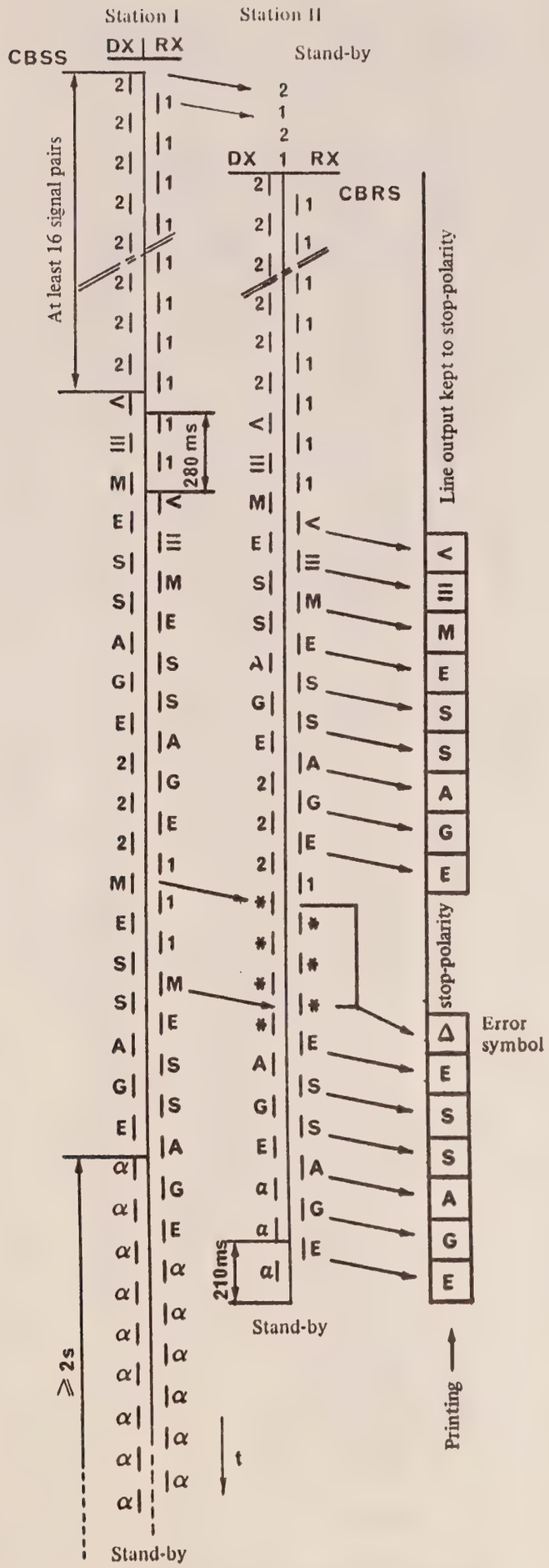


FIGURE 10 – *Collective B-mode operation*

1 : phasing signal 1
2 : phasing signal 2
* : Detected error

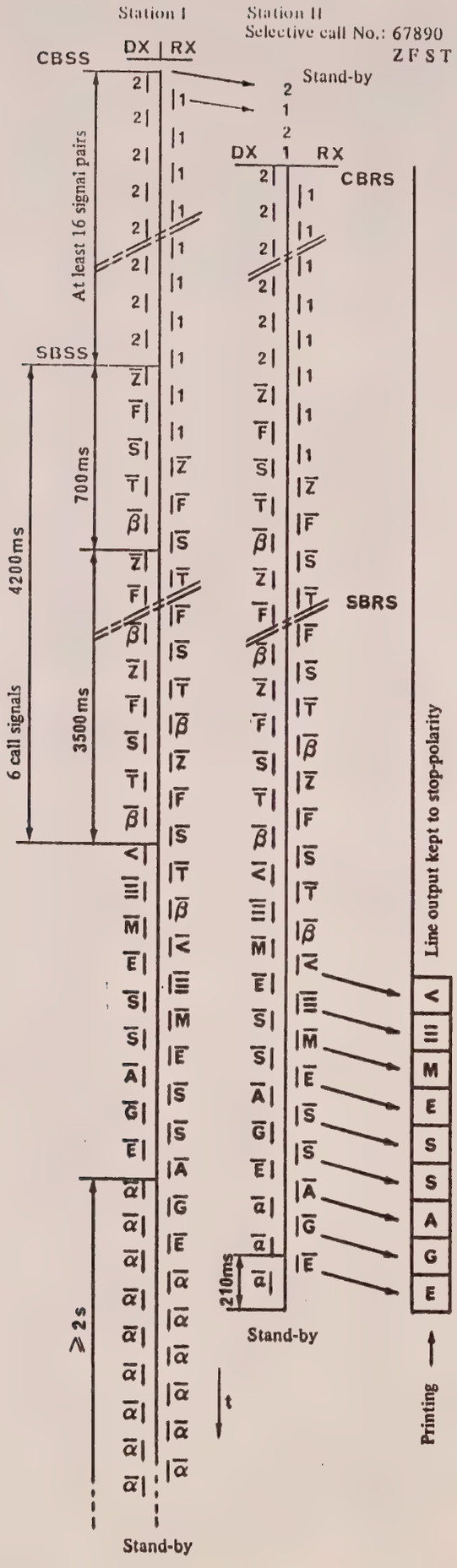


FIGURE 11 – *Selective B-mode operation in the case of a 4-signal call identity*

1 : phasing signal 1

2 : phasing signal 2

Overlined symbols (e.g. $\overline{M}$) are in the 3B/4Y ratio

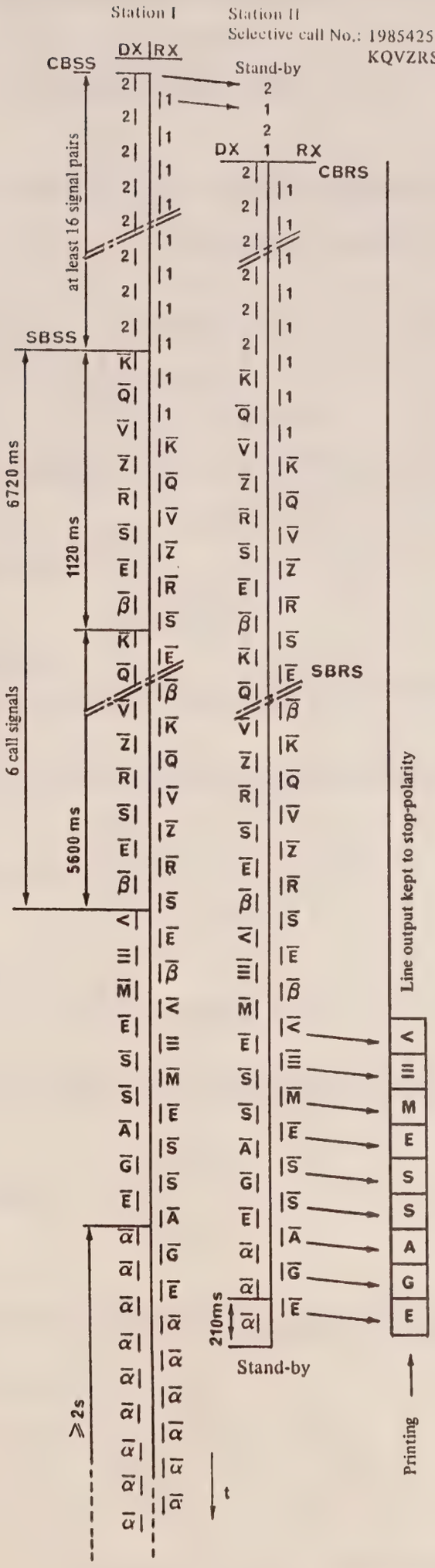


FIGURE 12 – *Selective B-mode operation in the case of a 7-signal call identity*

1: phasing signal 1

APPENDICES TO ANNEX I

APPENDIX I

SDL DIAGRAMS (MODE A)

1. General

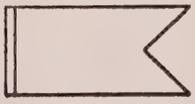
The specification and description language (SDL) is described in CCITT Recommendations Z.101 to Z.104.

The following graphical symbols have been used:

State

– A "state" is a condition in which the action of a process is suspended awaiting an input.

External input



Internal input

– An "input" is an incoming signal which is recognized by a process.

External output

Internal output

– An "output" is an action which generates a signal which in turn acts as an input elsewhere.

Decision

– A "decision" is an action which asks a question to which the answer can be obtained at that instant and chooses one of several paths to continue the sequence.

Task

– A "task" is any action which is neither a decision nor an output.

2. Phasing procedure with automatic identification in the case of a 7-signal call identity (calling station)

2.1 The SDL diagrams are given in Appendix II.

2.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_0	128 cycles	02, 03, 04	1
n_1	128 cycles	00	1
n_2	32 cycles	05, 06, 07, 08	2, 3

3. Rephasing procedure with automatic identification in the case of a 4-signal call identity (calling station)

3.1 The SDL diagrams are given in Appendix III.

3.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_5	32 cycles	00, 02, 03, 04	1
		05, 06, 07, 08	2, 3
n_1	128 cycles		1
n_2	32 cycles	05, 06, 07, 08	2, 3

4. Phasing procedure without automatic identification in the case of a 4-signal call identity (calling station)

4.1 The SDL diagrams are given in Appendix IV.

4.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_0	128 cycles	02, 03	1
n_1	128 cycles	00	1

5. Rephasing procedure without automatic identification in the case of a 4-signal call identity (calling station)

5.1 The SDL diagrams are given in Appendix V.

5.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_5	32 cycles	00, 02, 03	1
n_1	128 cycles		1

6. Phasing procedure with automatic identification in the case of a 7-signal call identity (called station)

6.1 The SDL diagrams are given in Appendix VI.

6.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_2	32 cycles	05, 06, 07, 08	2, 3

7. Rephasing procedure with automatic identification in the case of a 7-signal call identity (called station)

7.1 The SDL diagrams are given in Appendix VII.

7.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_5	32 cycles	00, 01, 02, 03, 04	1
		05, 06, 07, 08	2, 3
n_2	32 cycles	05, 06, 07, 08	2, 3

8. Phasing procedure without automatic identification in the case of 4-signal call identity (called station)

8.1 The SDL diagrams are given in Appendix VIII.

9. Rephasing procedure without automatic identification in the case of a 4-signal call identity (called station)

9.1 The SDL diagrams are given in Appendix IX.

9.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_5	32 cycles	00, 01, 03	1

10. Traffic flow in the case of a 4-signal call identity and in the case of a 7-signal call identity (station is in the ISS position)

10.1 The SDL diagrams are given in Appendix X.

10.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_3	32 cycles	09, 10, 13	1, 3
n_4	4 cycles	11, 12	2
n_1	128 cycles	12	2
n_5	32 cycles	11, 12, 13, 14	2, 3

11. Traffic flow in the case of a 4-signal call identity and in the case of a 7-signal call identity (station is in the IRS position)

11.1 The SDL diagrams are given in the Appendix XI.

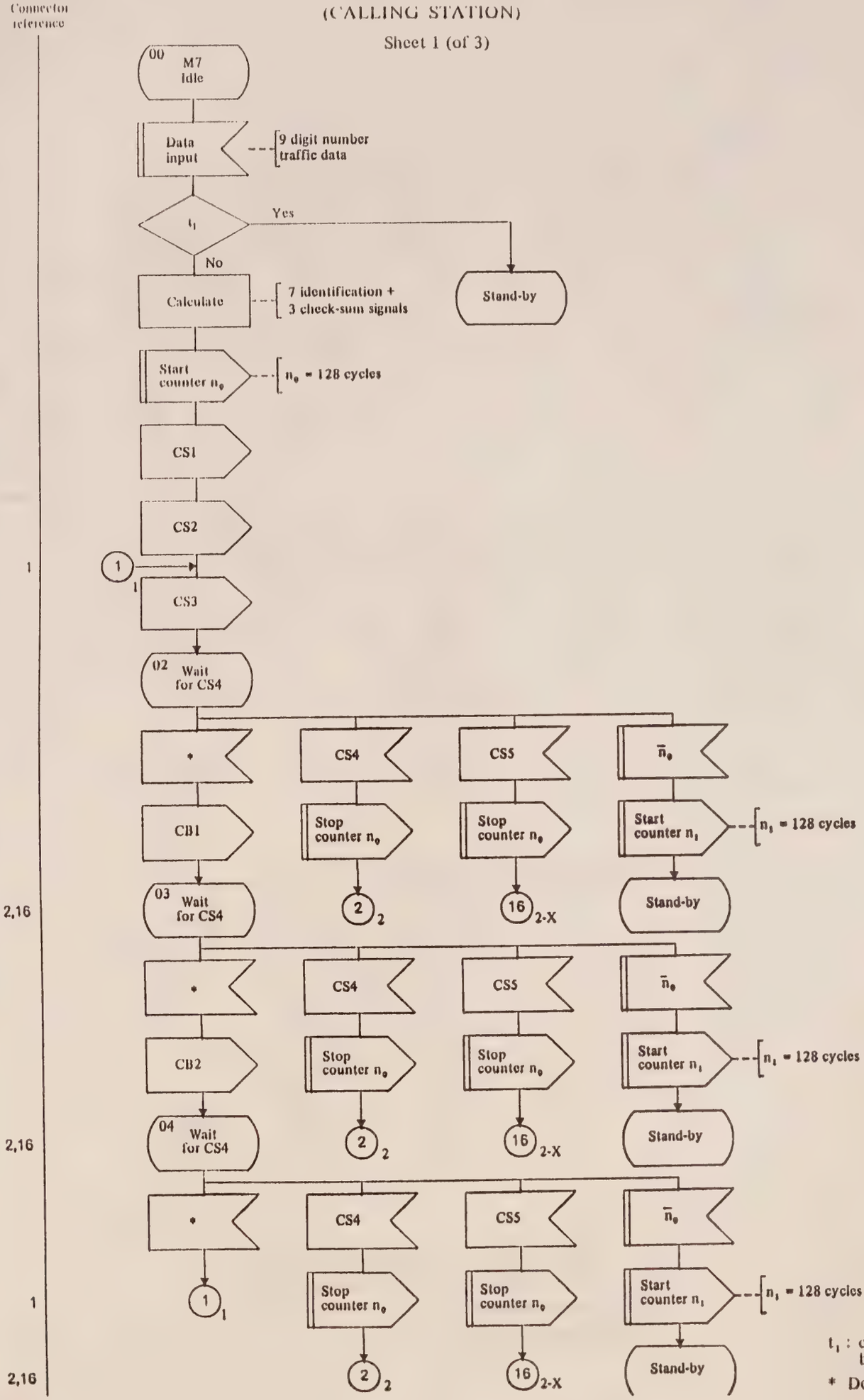
11.2 The following supervisory counters are used in the diagrams:

Counter	Time-out	State	Sheet
n_3	32 cycles	09, 10, 11	1, 2
n_5	32 cycles	09, 10, 11, 12	1, 2

APPENDIX II

PHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLING STATION)

Sheet 1 (of 3)

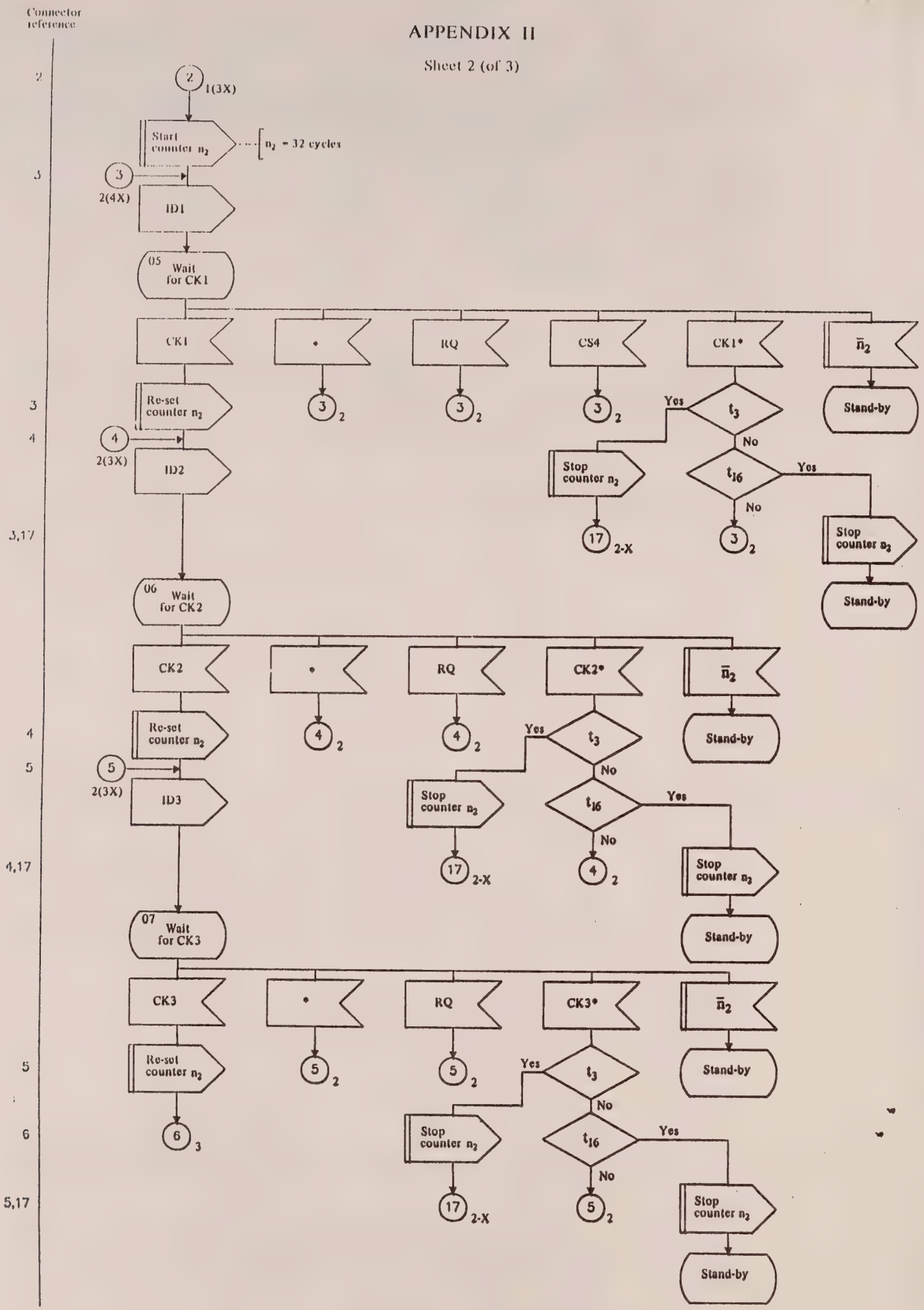


t_1 : call identity the same as the one before and $n_1 > 0$?

* Detected error or no signal at all

APPENDIX II

Sheet 2 (of 3)



t_{16} : fourth reception of a wrong check-sum signal?

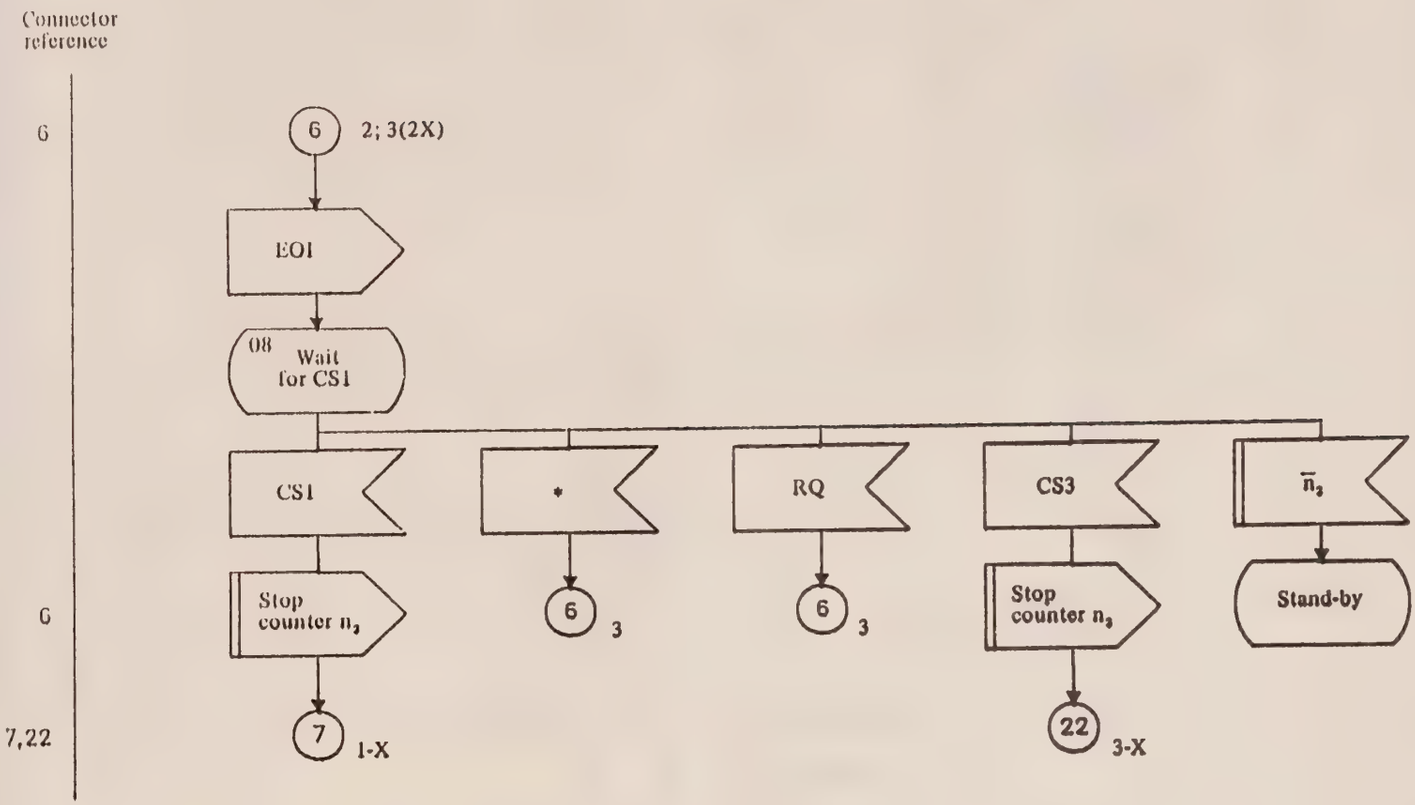
t_3 : same wrong check-sum signal one cycle before?

CKn* : wrong check-sum signal

* Detected error or no signal at all

APPENDIX II

Sheet 3 (of 3)

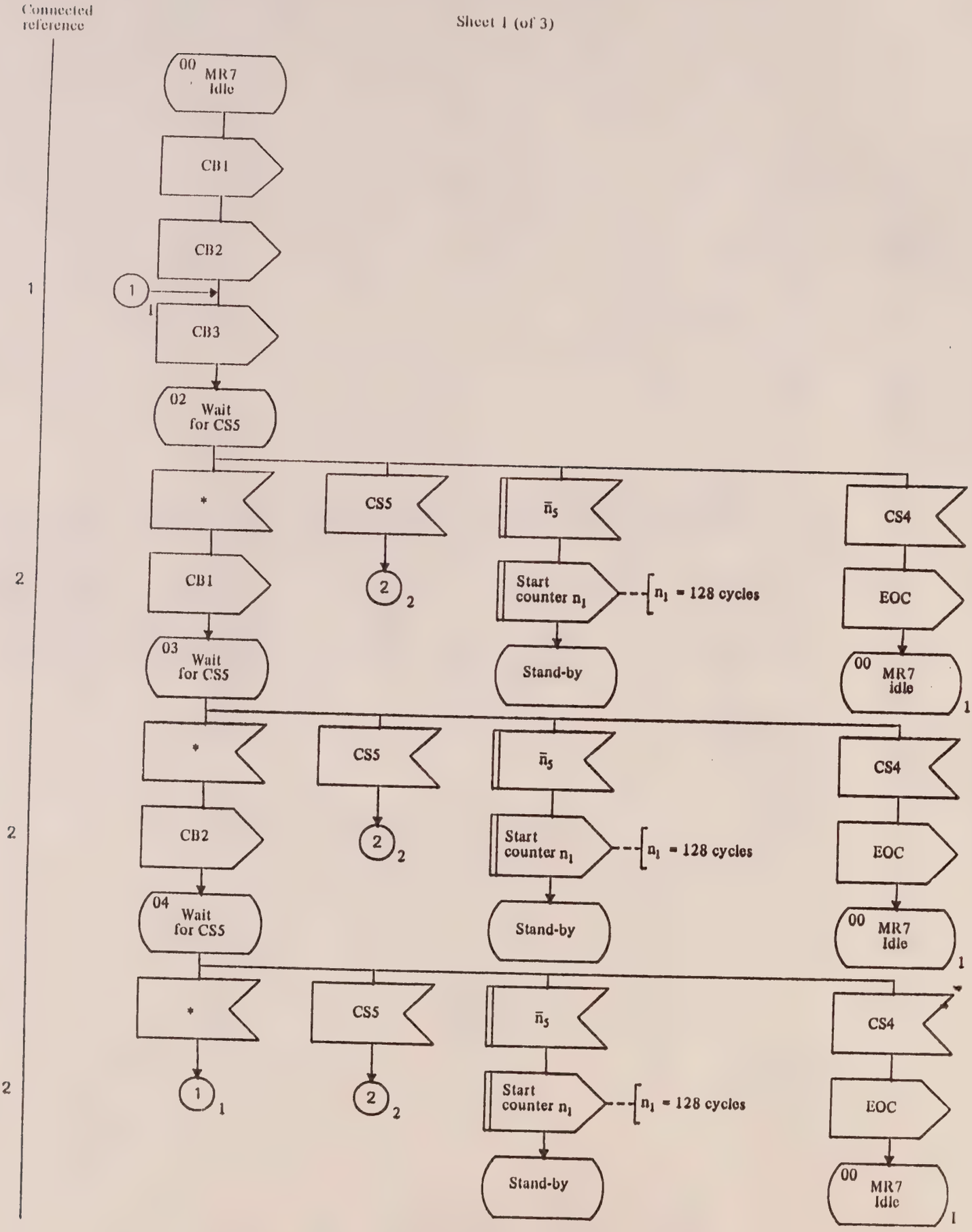


* Detected error or no signal at all

APPENDIX III

PHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLING STATION)

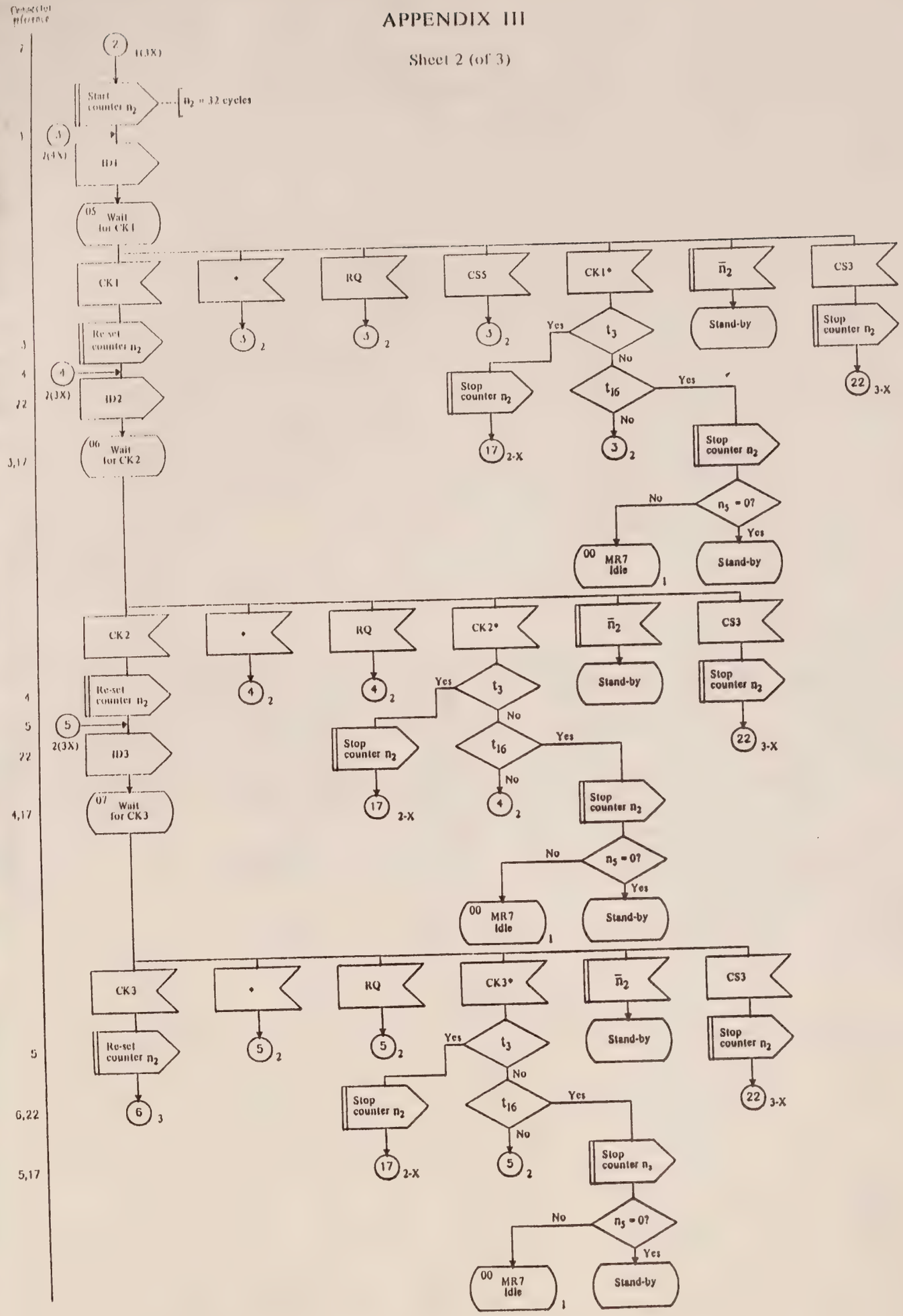
Sheet 1 (of 3)



* Detected error or no signal at all

APPENDIX III

Sheet 2 (of 3)



t_{16} : fourth reception of a wrong check-sum signal?

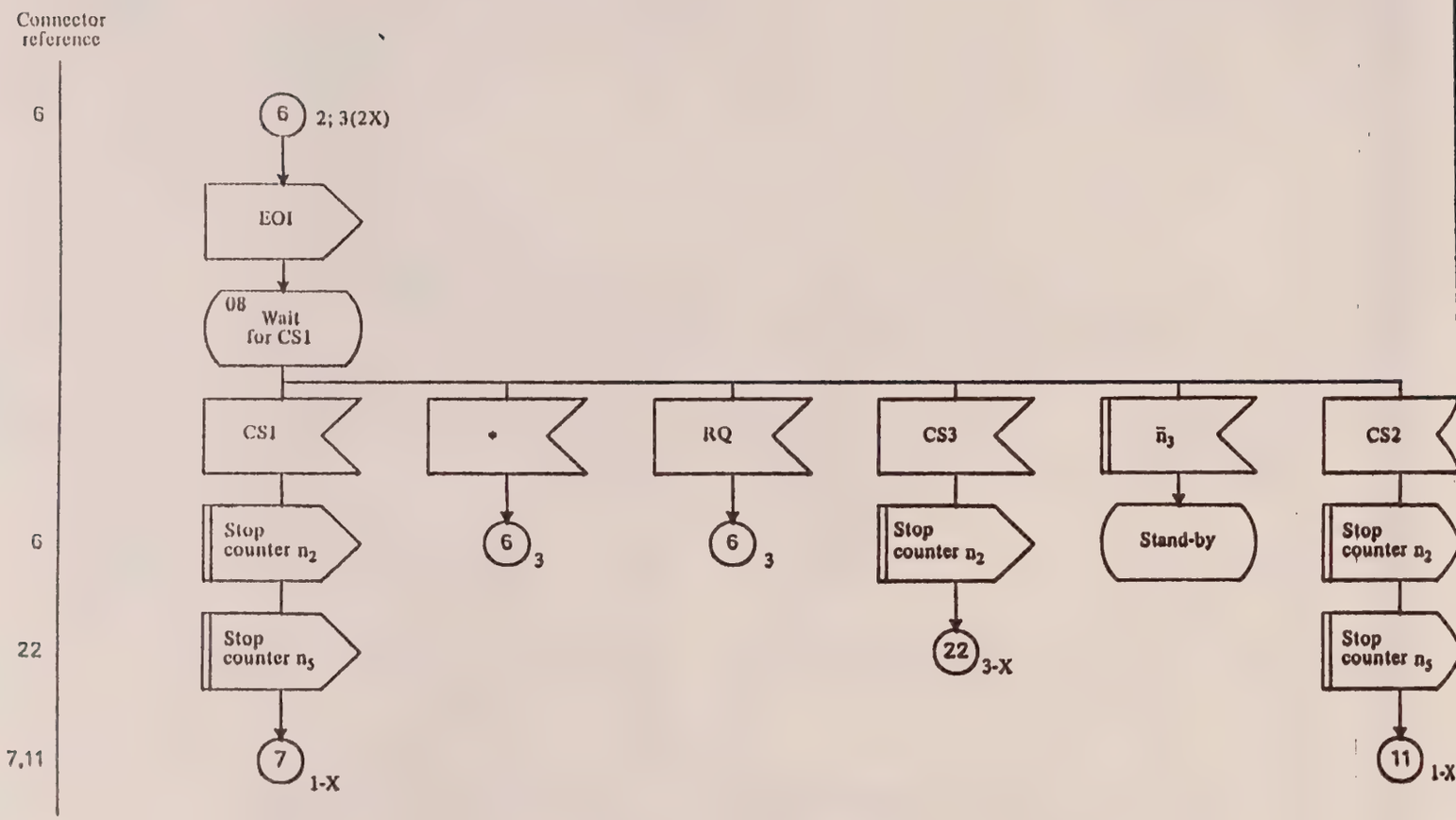
t_3 : same wrong check-sum signal one cycle before?

CKn* : wrong check-sum signal

* Detected error or no signal at all

APPENDIX III

Sheet 3 (of 3)

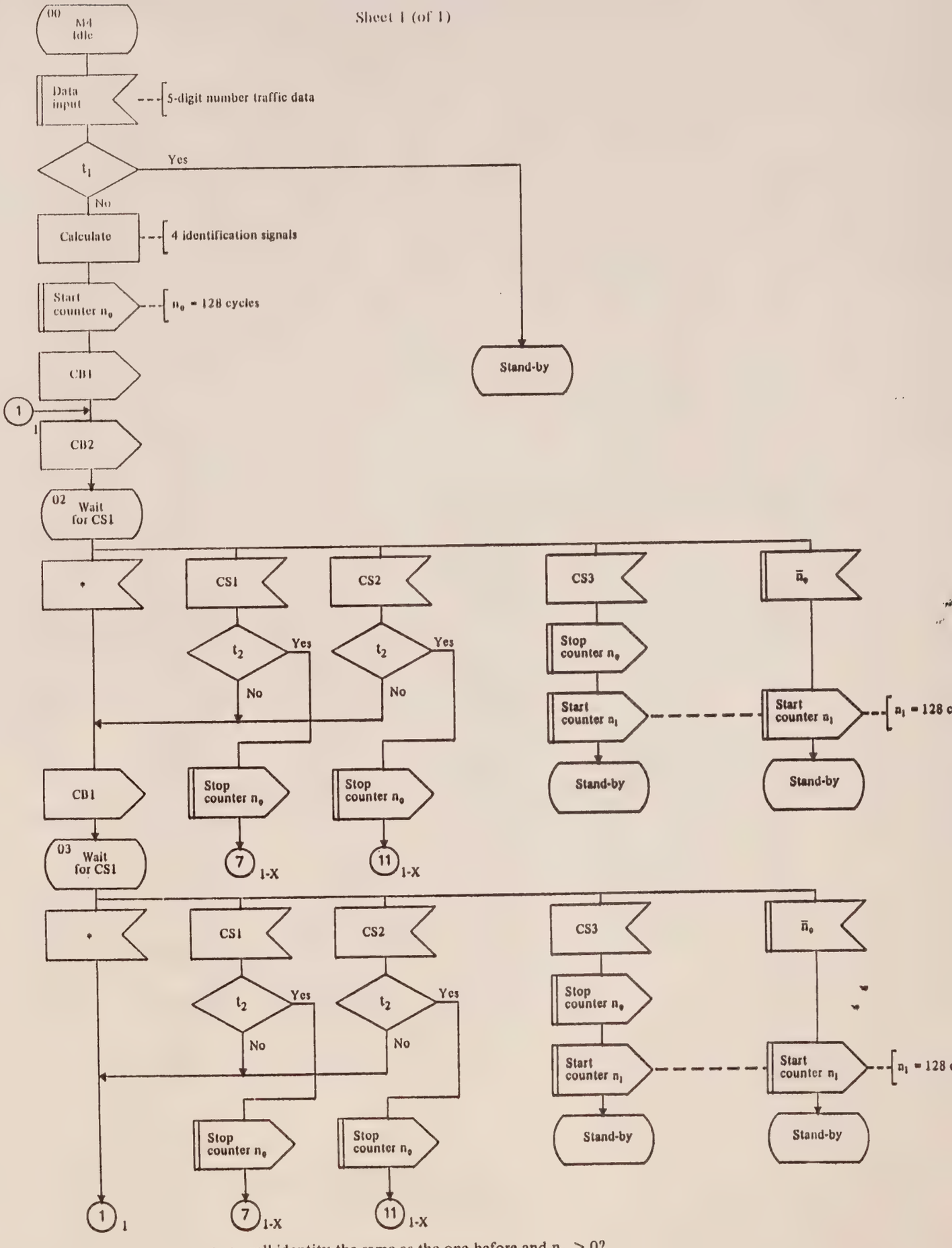


* Detected error or no signal at all

APPENDIX IV

PHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLING STATION)

Sheet 1 (of 1)



t_1 : call identity the same as the one before and $n_1 > 0$?

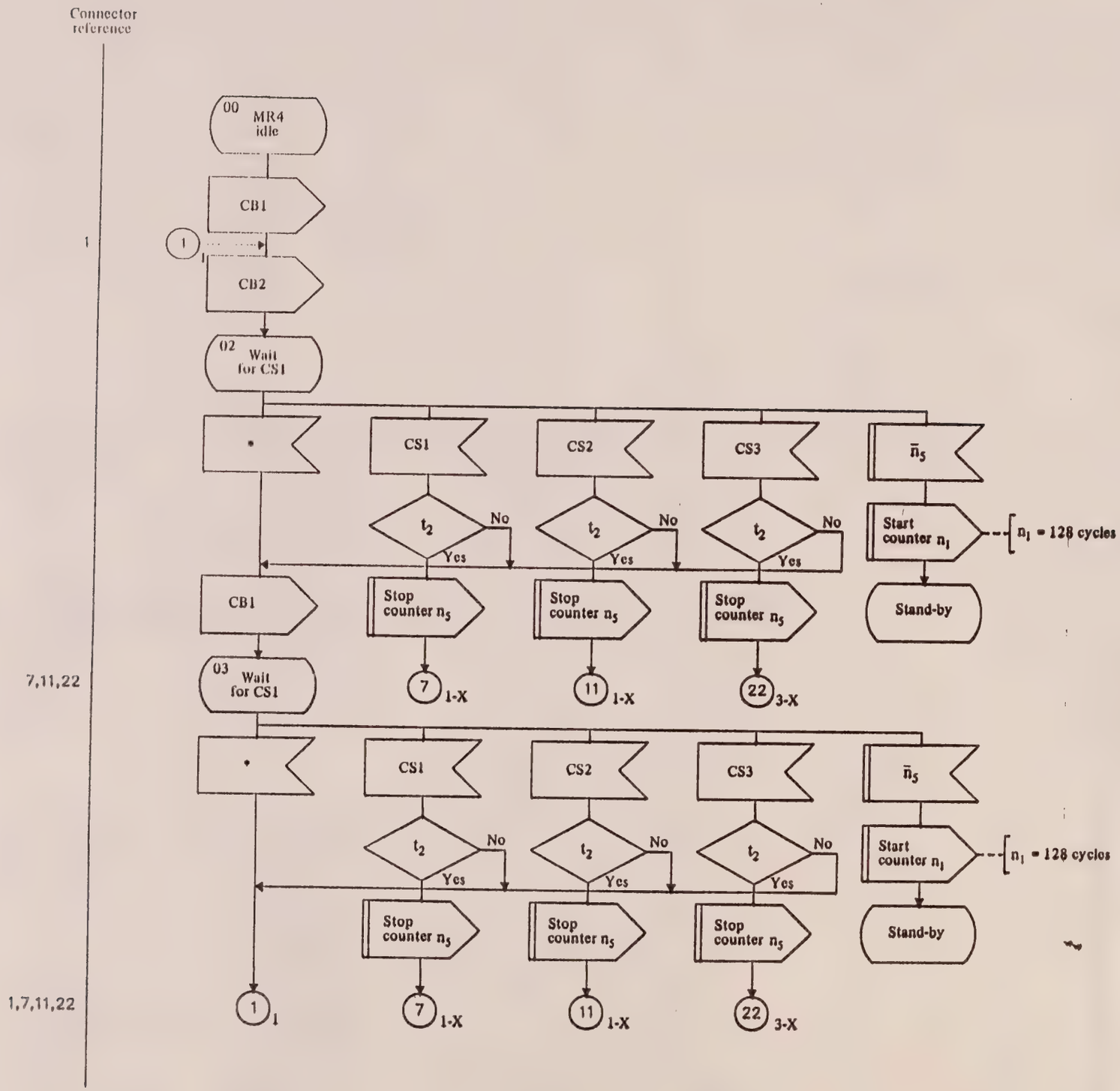
t_2 : same control signal one cycle before?

* Detected error or no signal at all

APPENDIX V

REPHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLING STATION)

Sheet 1 (of 1)



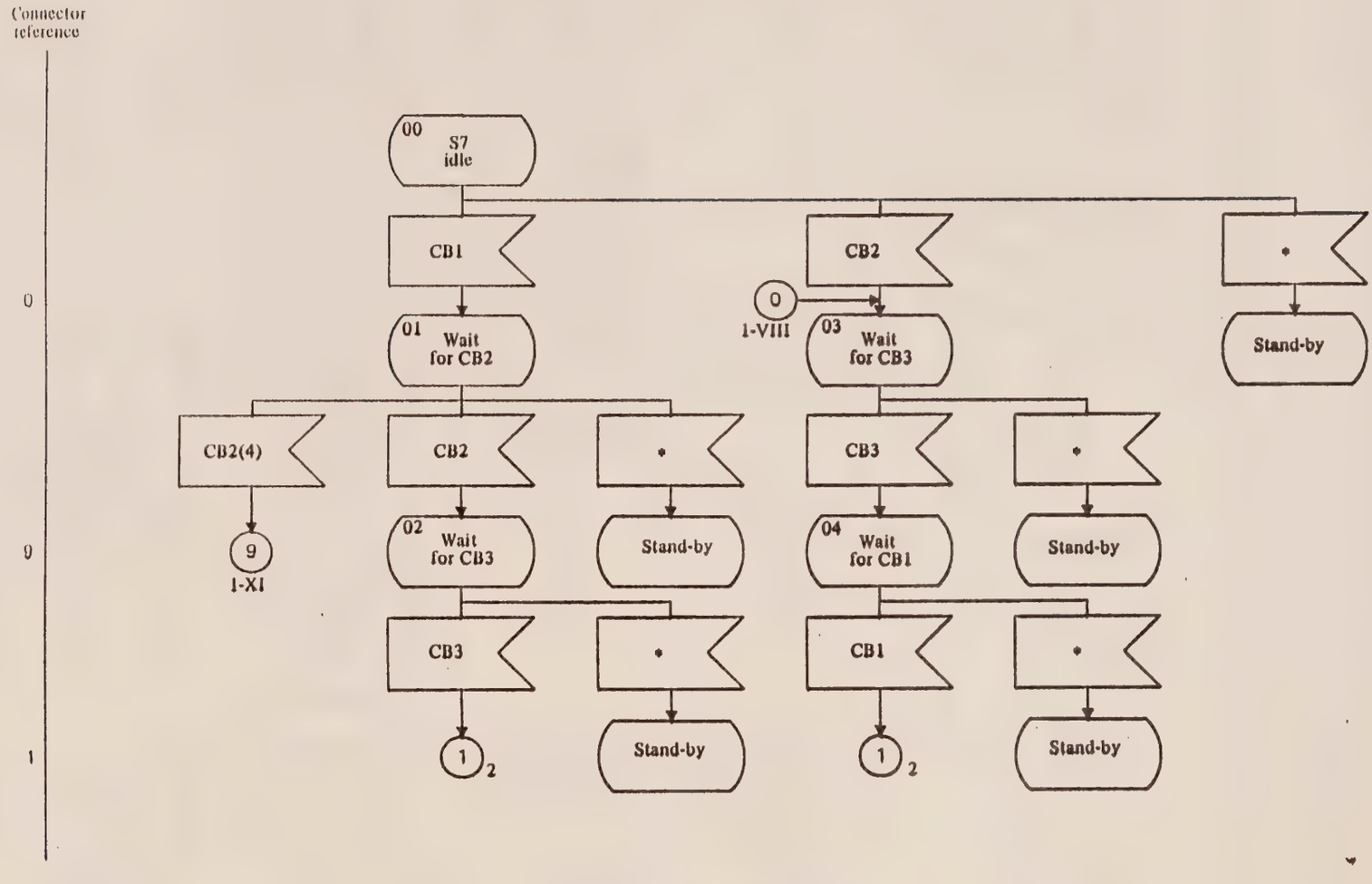
t_2 : same control signal one cycle before?

* Detected error or no signal at all

APPENDIX VI

PHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLED STATION)

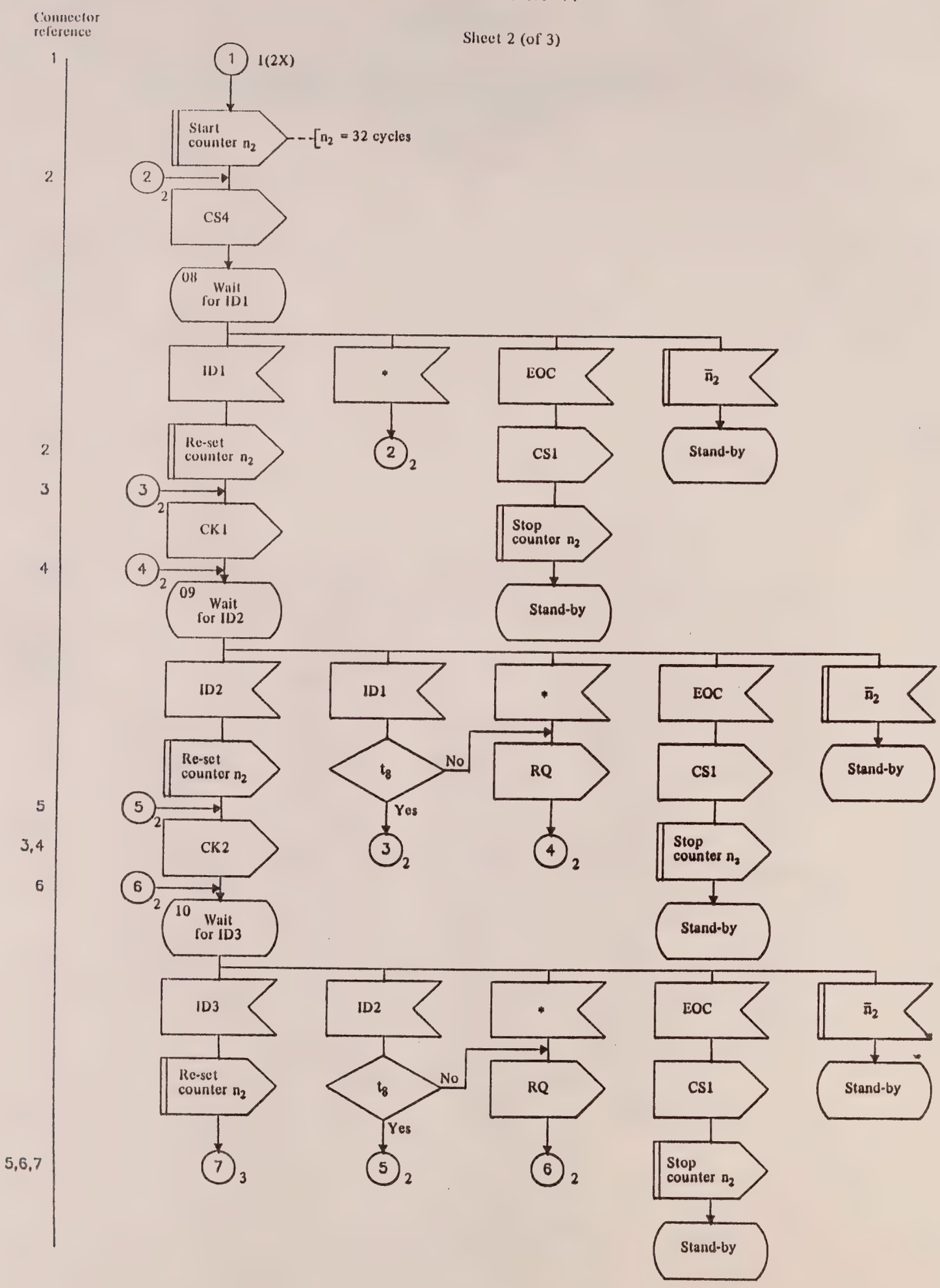
Sheet 1 (of 3)



* Detected error or no signal at all

APPENDIX VI

Sheet 2 (of 3)

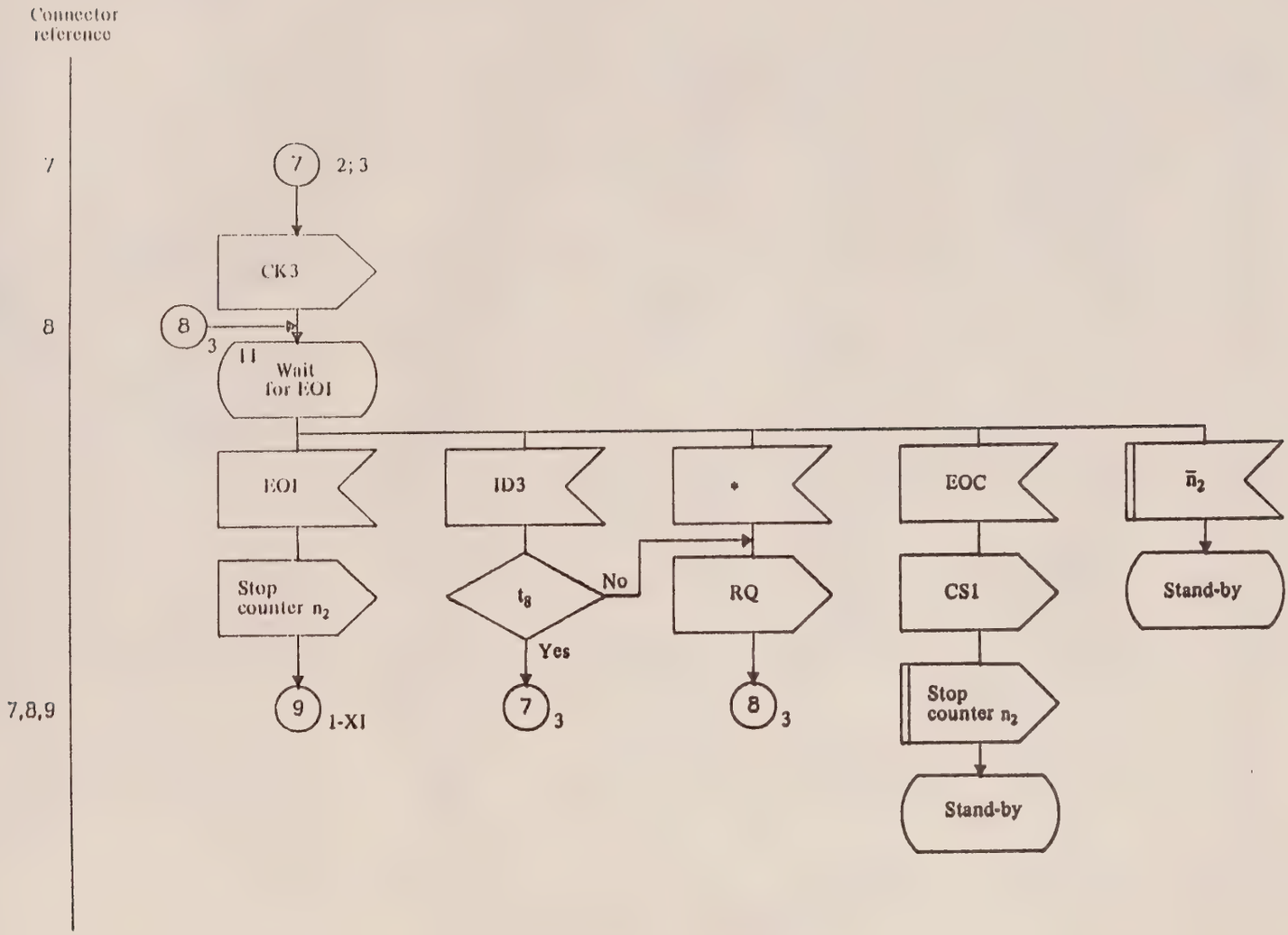


t_8 : same ID-block one cycle before?

* Detected error or no signal at all

APPENDIX VI

Sheet 3 (of 3)



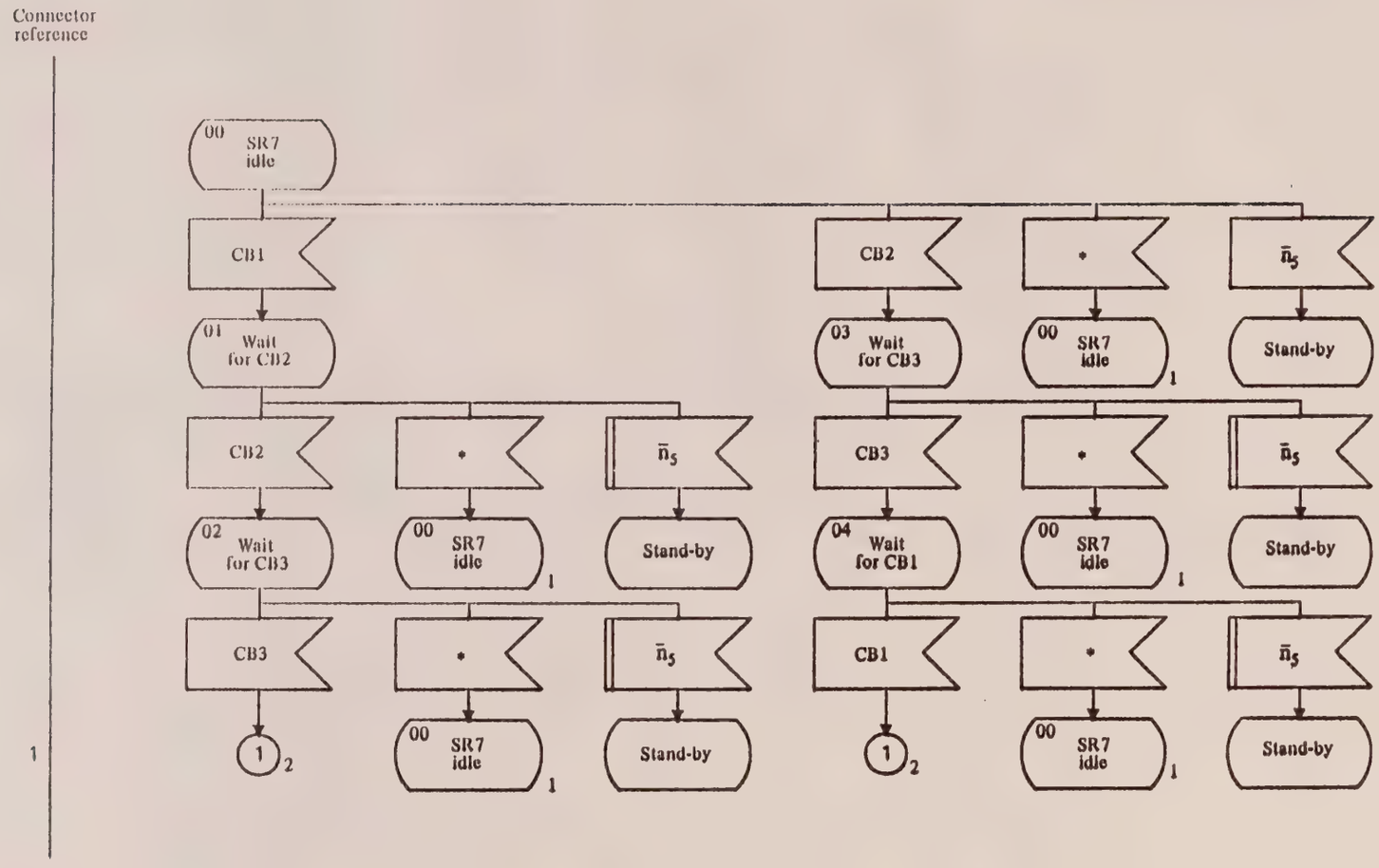
t_8 : same ID-block one cycle before?

* Detected error or no signal at all

APPENDIX VII

REPHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLED STATION)

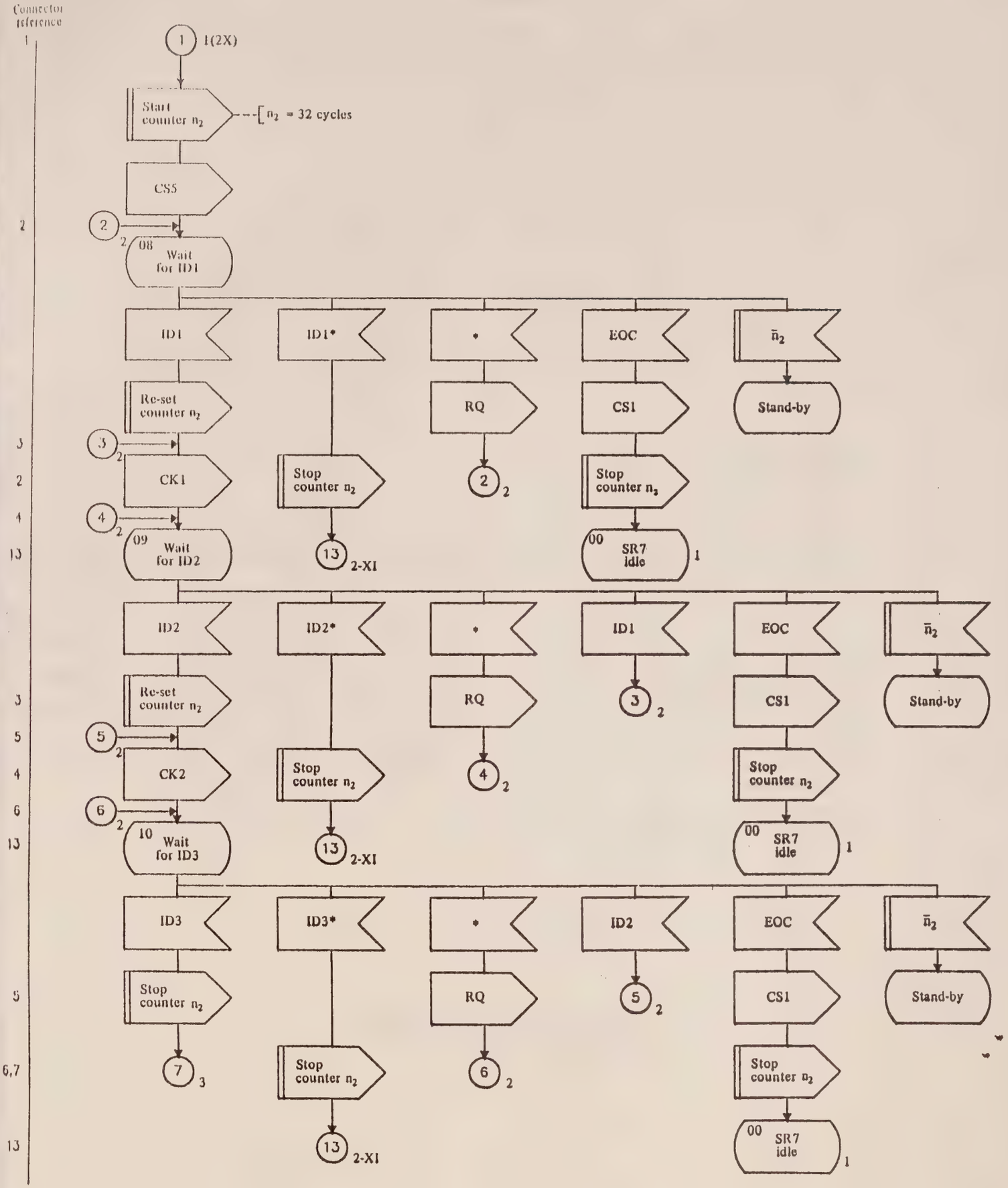
Sheet 1 (of 3)



* Detected error or no signal at all

APPENDIX VII

Sheet 2 (of 3)

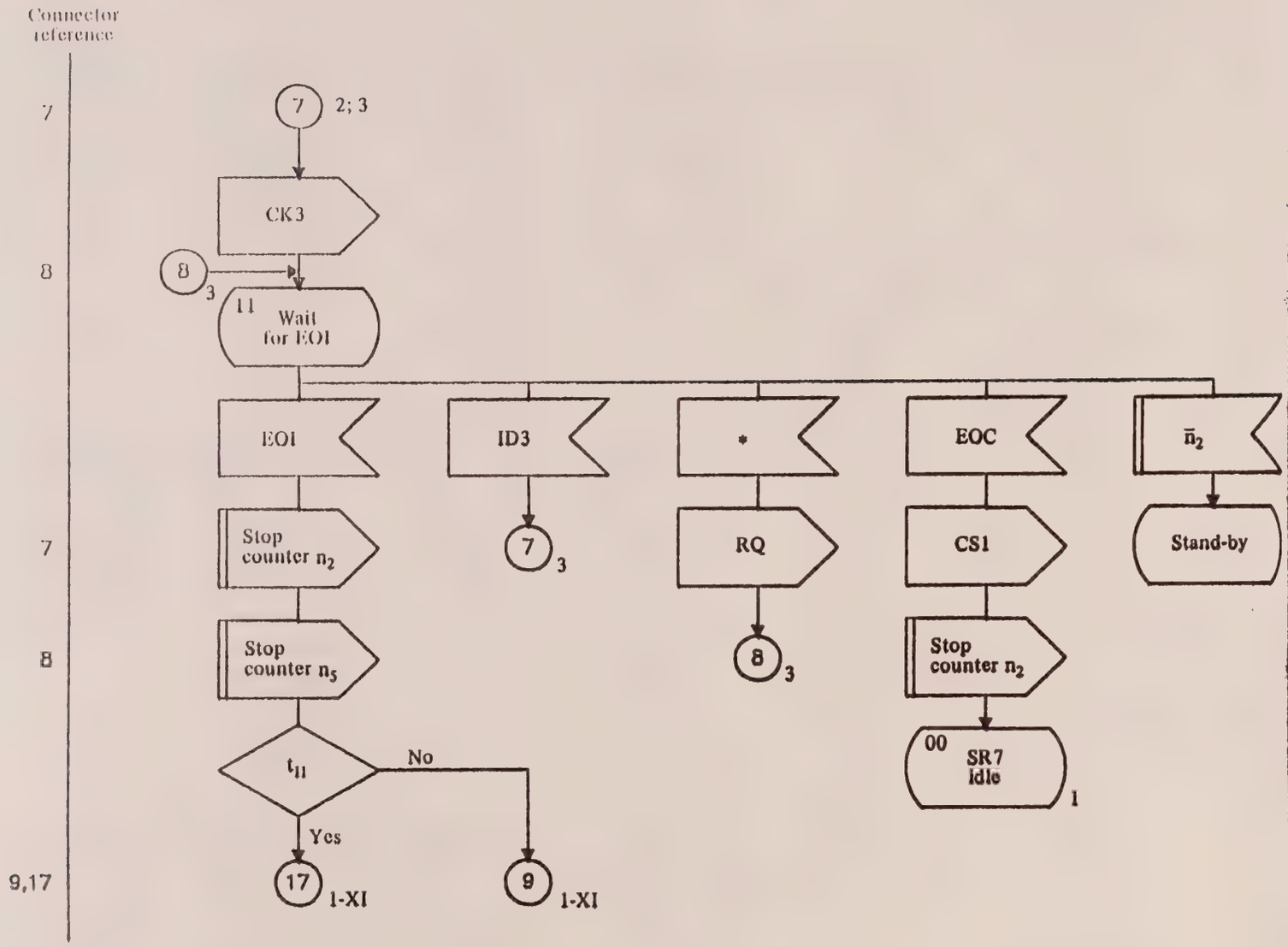


IDn*: wrong identification signal(s)

* Detected error or no signal at all

APPENDIX VII

Sheet 3 (of 3)



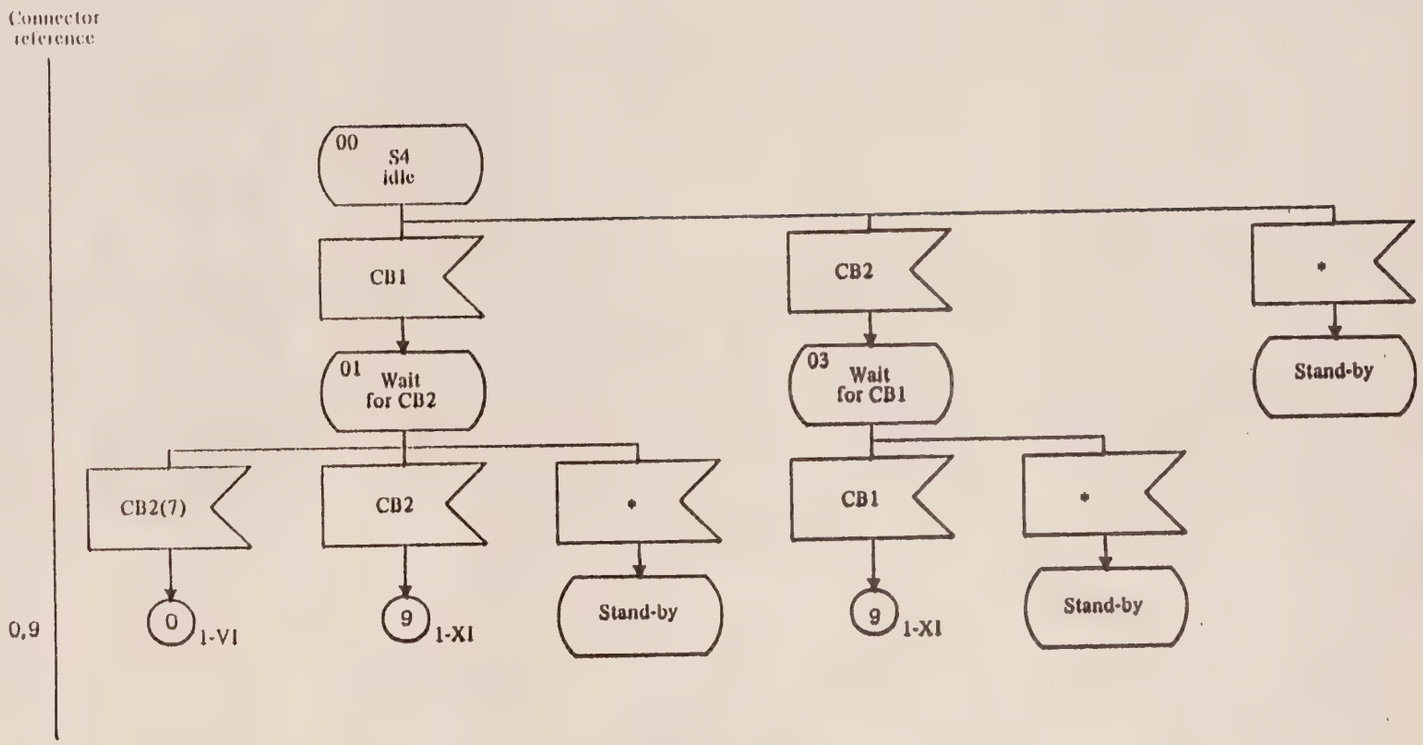
t_{11} : block 2 was the last received block at the moment the interruption occurred?

* Detected error or no signal at all

APPENDIX VIII

PHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLED STATION)

Sheet 1 (of 1)

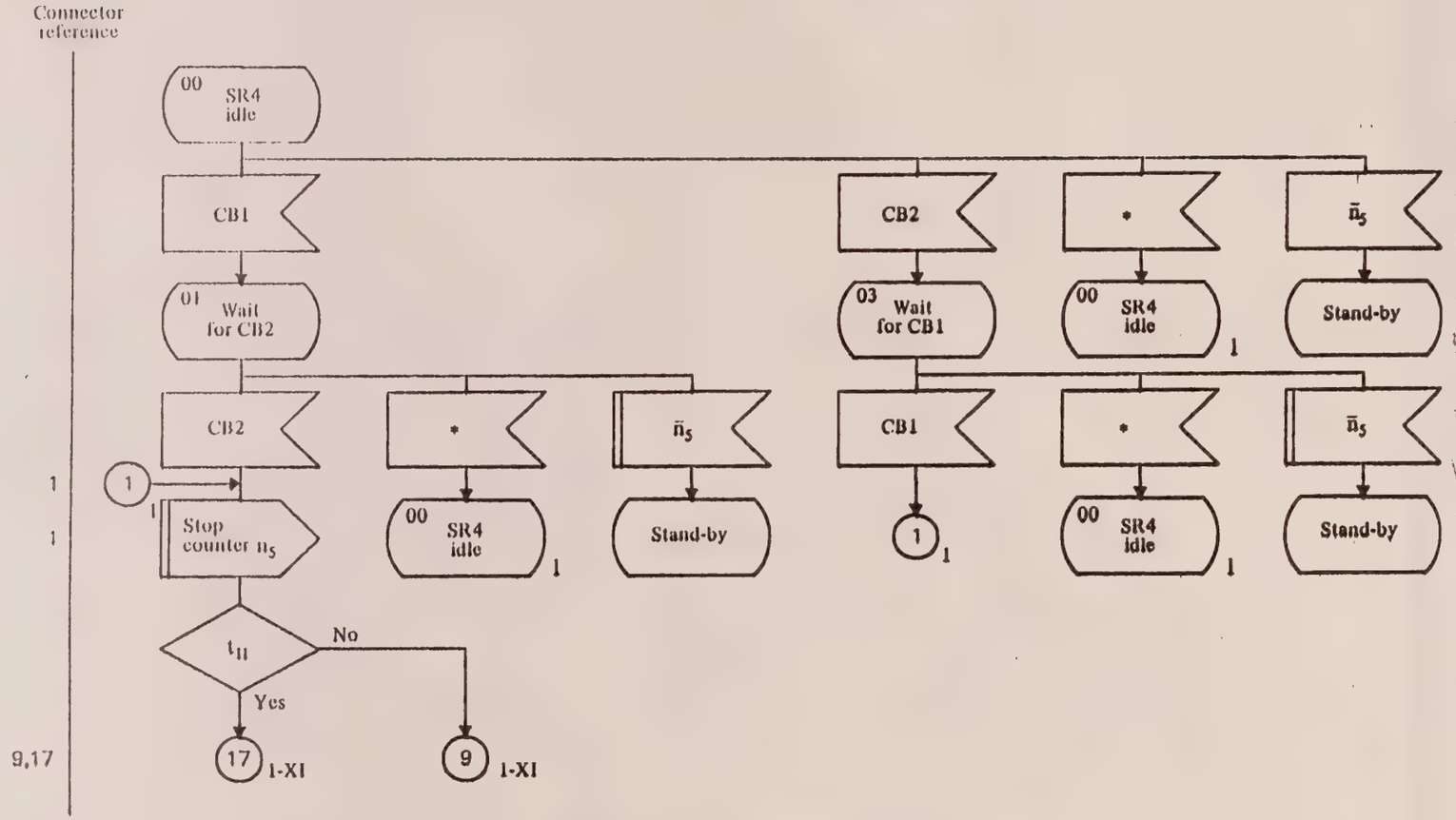


* Detected error or no signal at all

APPENDIX IX

REPHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLED STATION)

Sheet 1 (of 1)



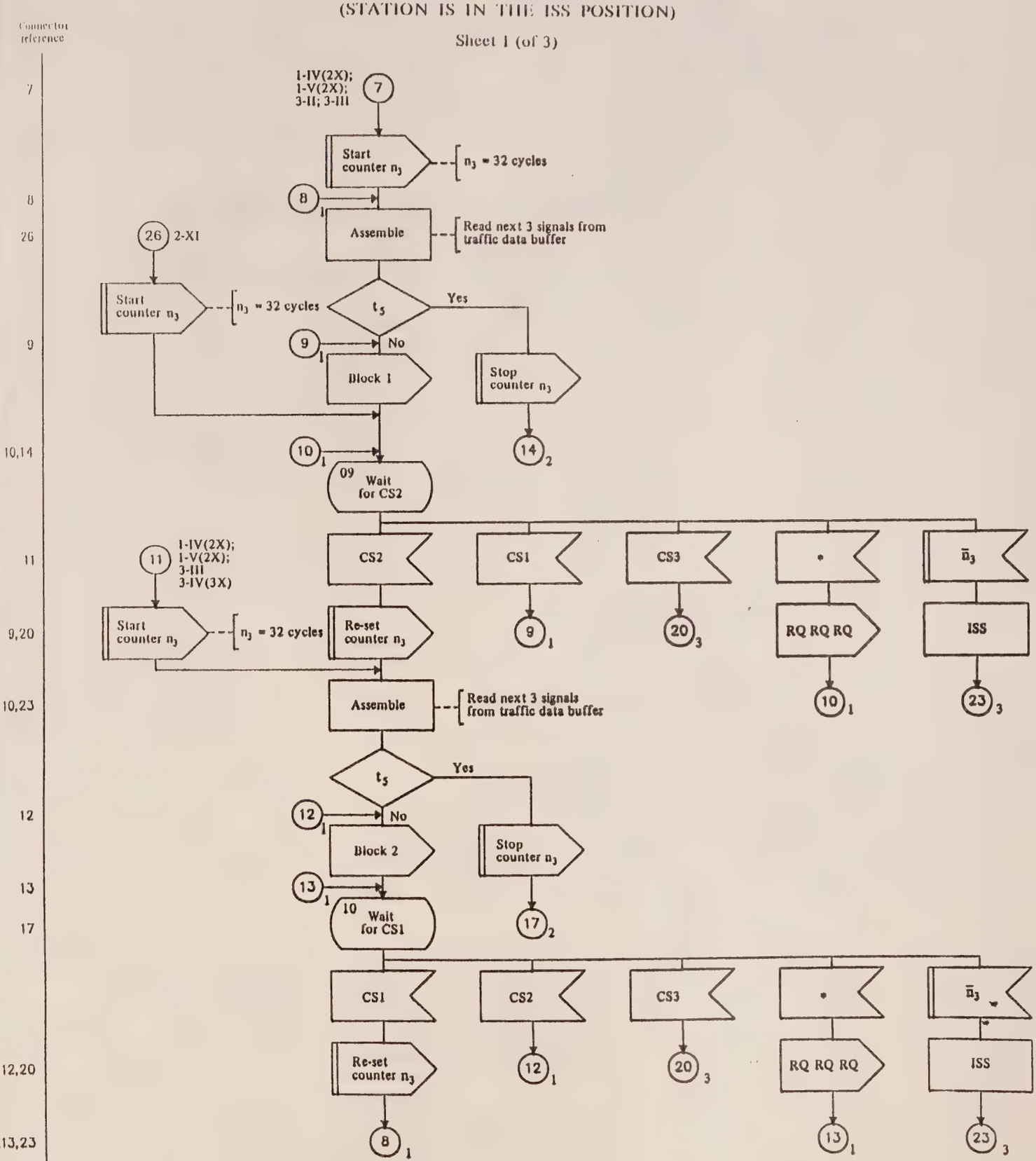
t_{11}: block 2 was the last received block at the moment the interruption occurred?

* Detected error or no signal at all

APPENDIX X

TRAFFIC FLOW IN THE CASE OF A 4-SIGNAL CALL IDENTITY AND IN THE CASE OF A 7-SIGNAL CALL IDENTITY (STATION IS IN THE ISS POSITION)

Sheet 1 (of 3)



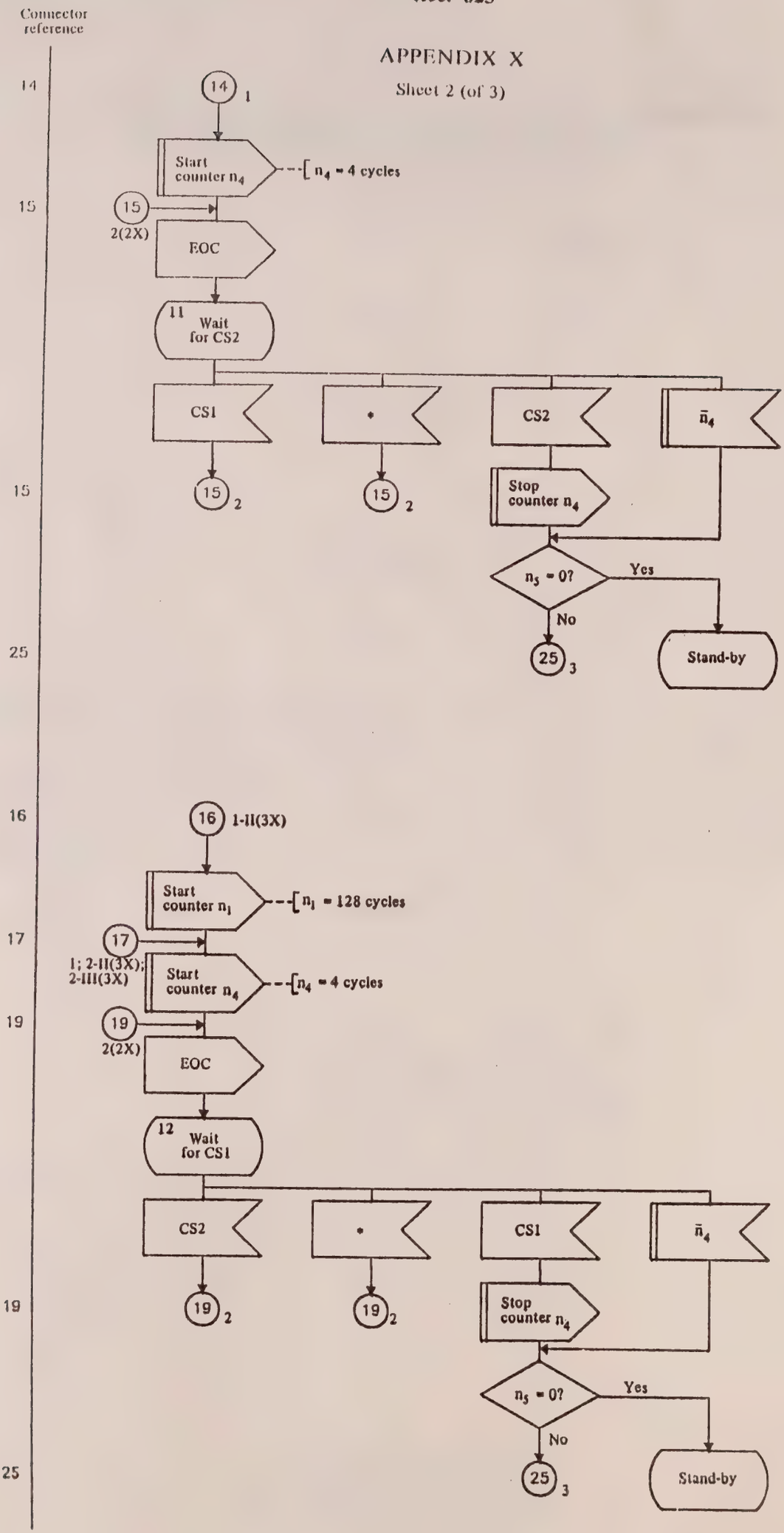
t_s : data block contains message "end-of-communication"?

ISS: notice: station is ISS at the moment the interruption occurred

* Detected error or no signal at all

APPENDIX X

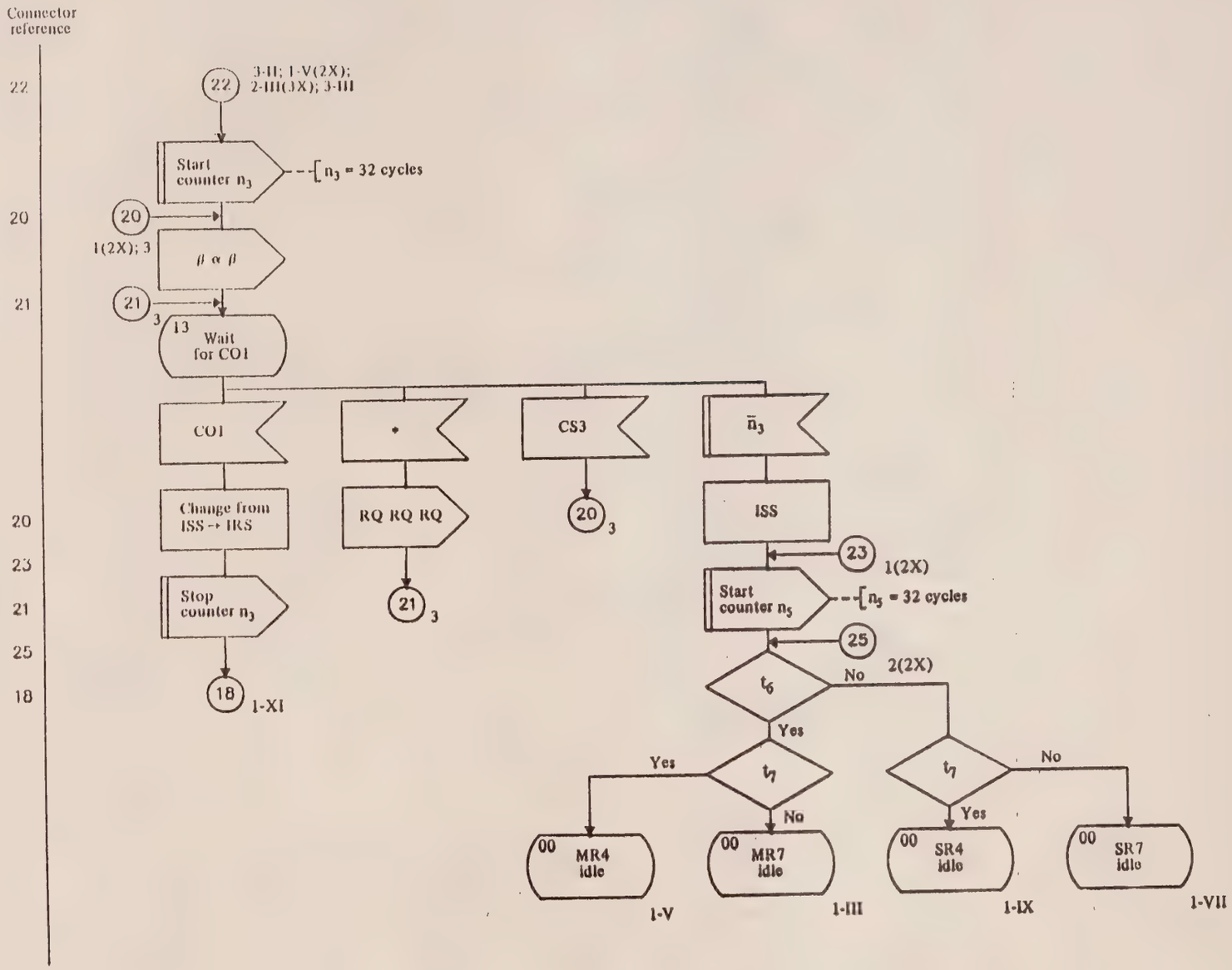
Sheet 2 (of 3)



* Detected error or no signal at all

APPENDIX X

Sheet 3 (of 3)



t_6 : station is master station?

t_7 : station working in the case of a 4-position call identity?

ISS : notice: station is ISS at the moment the interruption occurred

CO1: if ISS is:

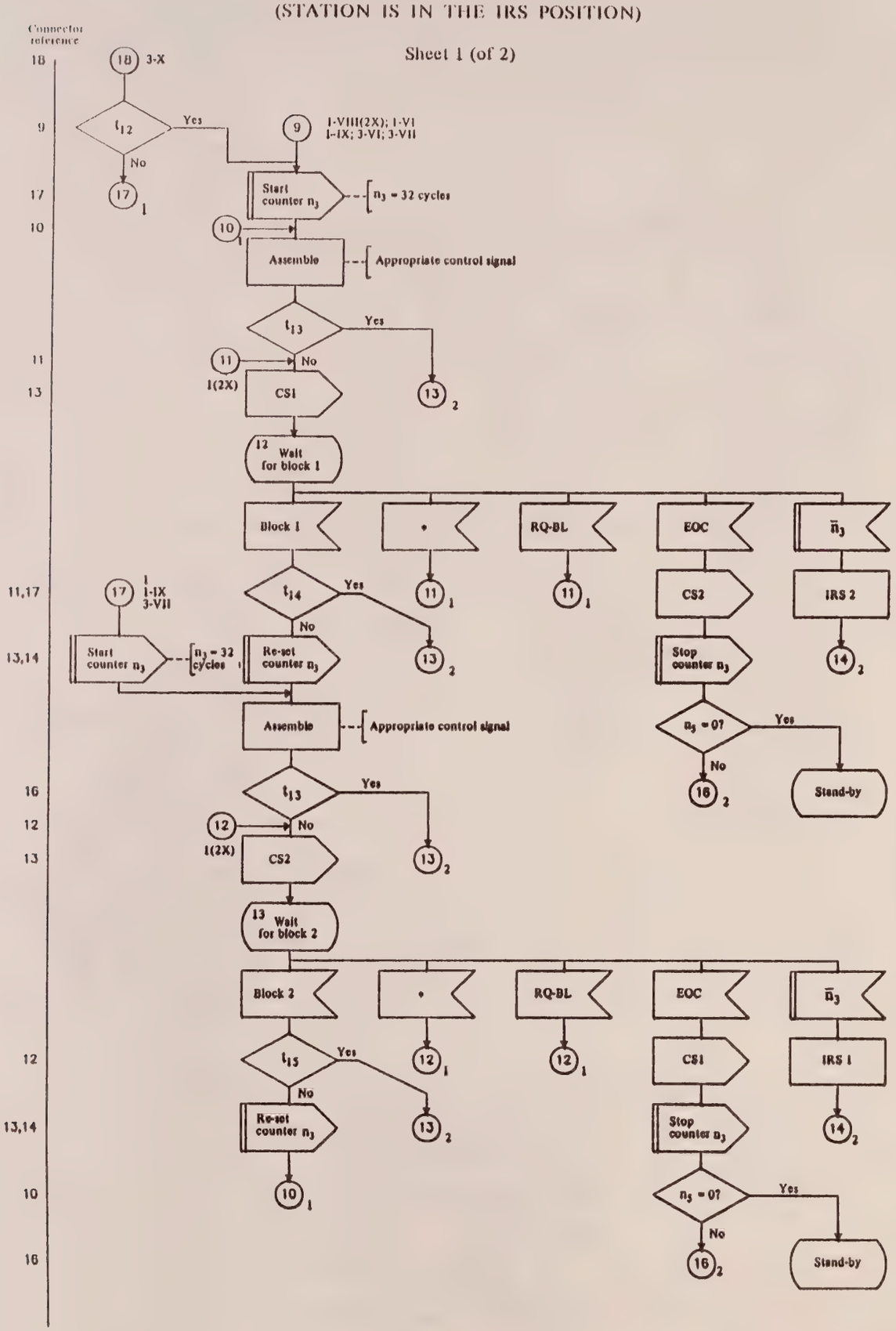
- master then "RQ RQ RQ",
- slave then "RQ"

* Detected error or no signal at all

APPENDIX XI

TRAFFIC FLOW IN THE CASE OF A 4-SIGNAL CALL IDENTITY AND IN THE CASE OF A 7-SIGNAL CALL IDENTITY (STATION IS IN THE IRS POSITION)

Sheet 1 (of 2)



t_{12} : block 2 was the last received block?

t_{13} : the emitting control signal is CS3?

t_{14} : block 1 with or without the previous block 2 contains the sequence "+ ?"?

t_{15} : block 2 with or without the previous block 1 contains the sequence "+ ?"?

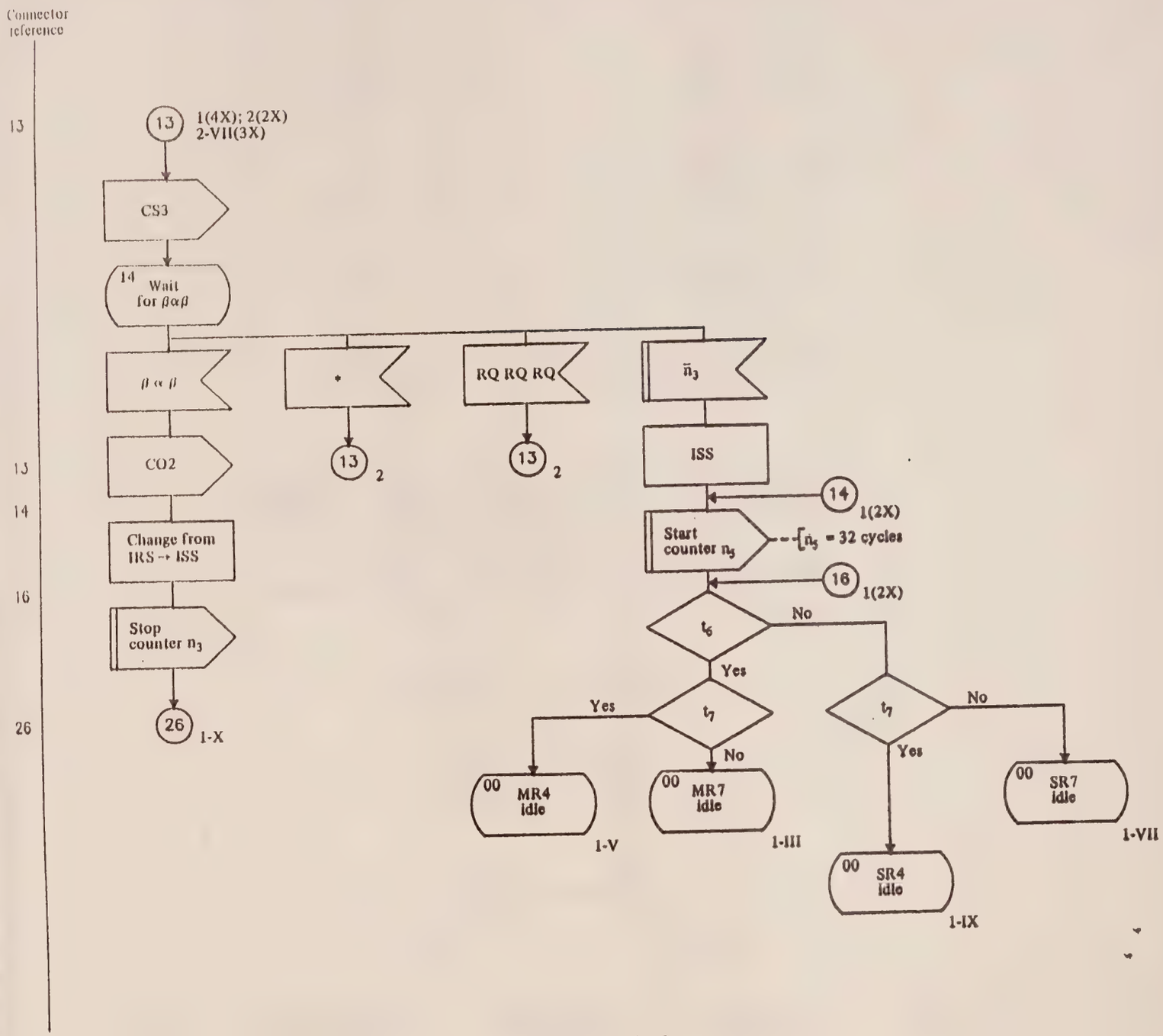
IRS1: notice: station is IRS at the moment the interruption occurred, last received block 1

IRS2: notice: station is IRS at the moment the interruption occurred, last received block 2

* Detected error or no signal at all

APPENDIX XI

Sheet 2 (of 2)



t_6 : station is master station?

t_7 : station working in the case of a 4-signal call identity?

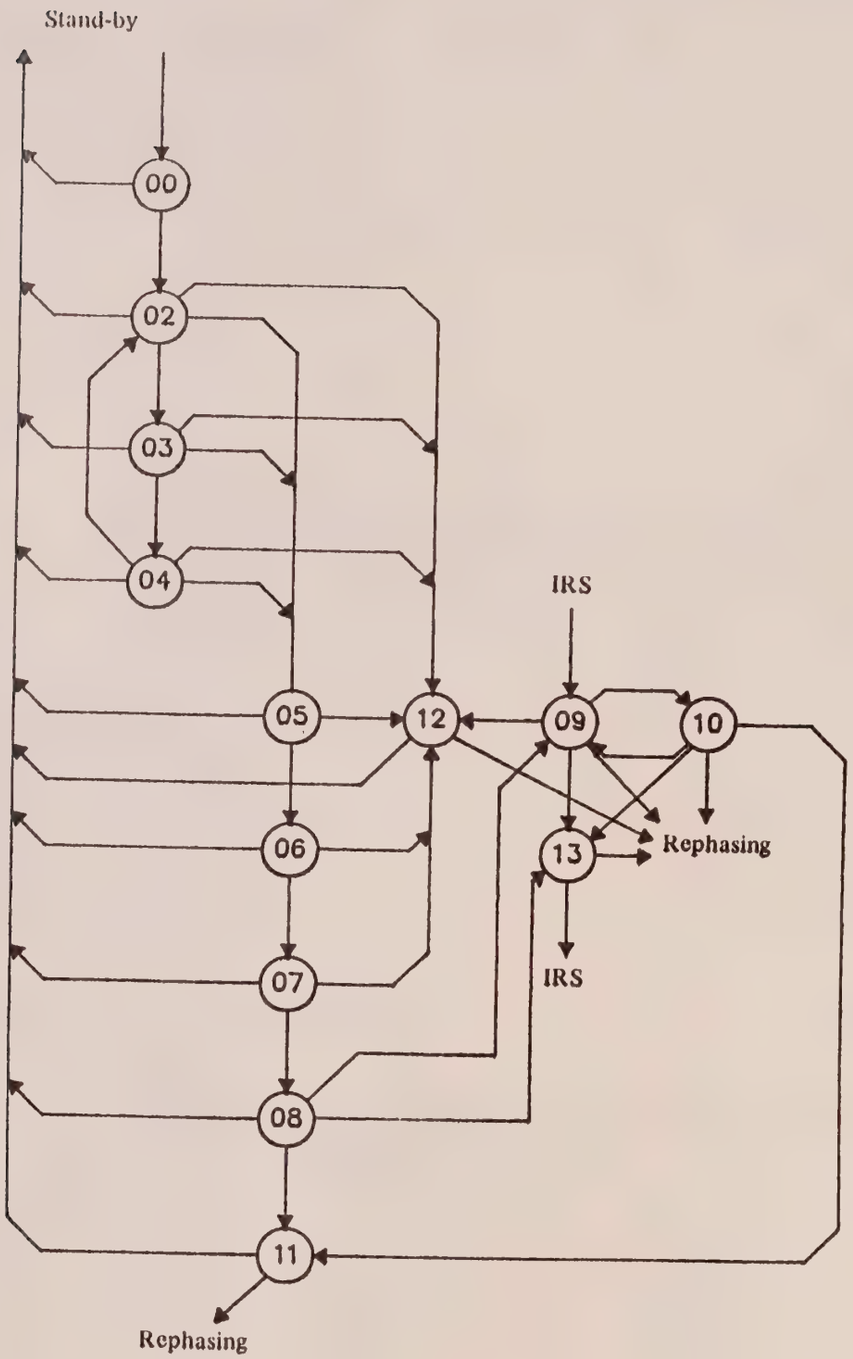
CO2 : if IRS is:
- master then "RQ";
- slave then "RQ RQ RQ"

* Detected error or no signal at all

APPENDIX XII

PHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLING STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE ISS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 1 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	M7 idle	1-II	n_1
02	Wait for CS4	1-II	n_0
03	Wait for CS4	1-II	n_0
04	Wait for CS4	1-II	n_0
05	Wait for CK1	2-II	n_2
06	Wait for CK2	2-II	n_2
07	Wait for CK3	2-II	n_2
08	Wait for CS1	3-II	n_2
09	Wait for CS2	1-X	n_3
10	Wait for CS1	1-X	n_3
11	Wait for CS2	2-X	n_4
12	Wait for CS1	2-X	n_1, n_4
13	Wait for change-over	3-X	n_3

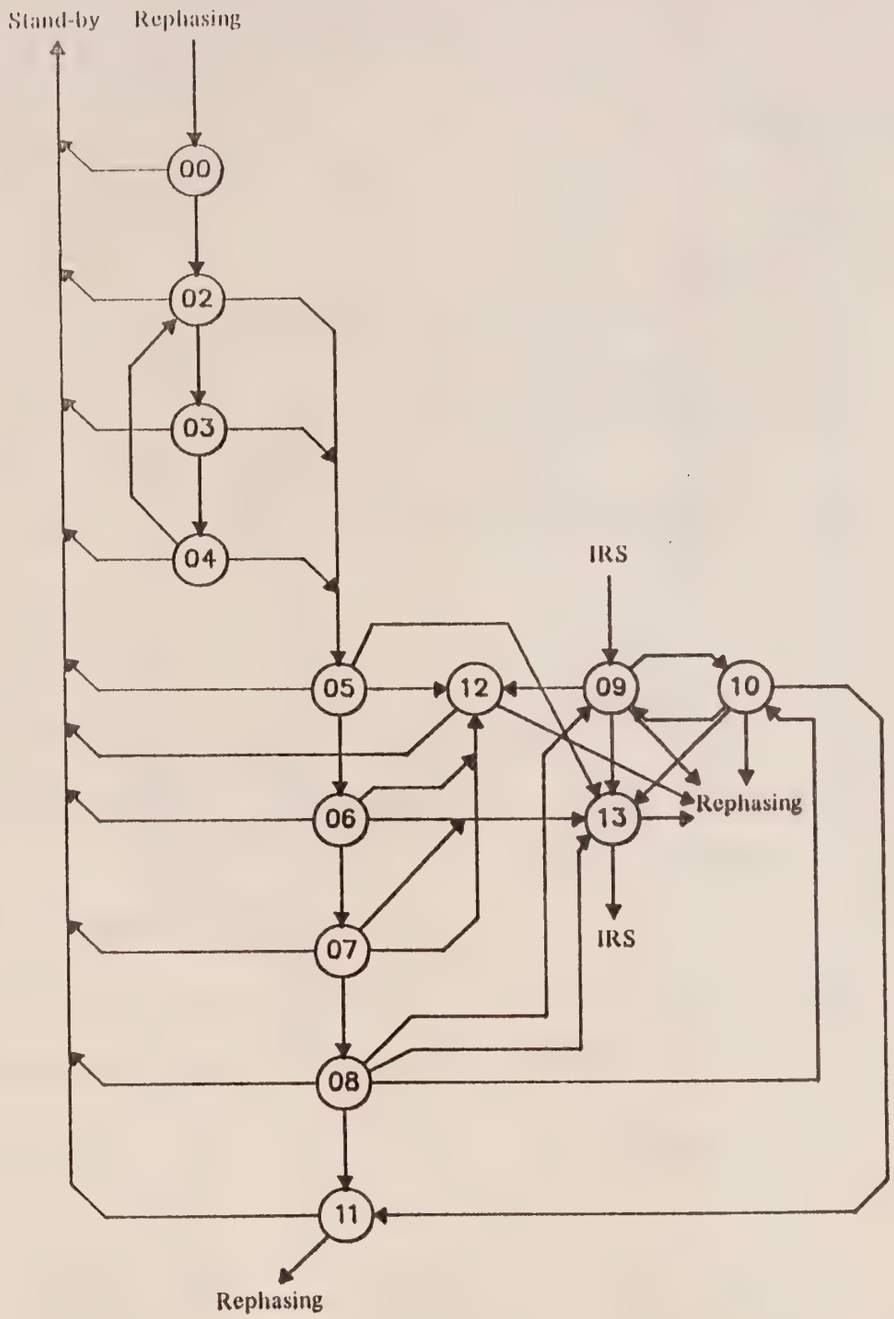
Supervisory counters

n_0 = 128 cycles
n_1 = 128 cycles
n_2 = 32 cycles
n_3 = 32 cycles
n_4 = 4 cycles

APPENDIX XII

REPHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLING STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE ISS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 2 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	MR7 idle	1-III	n_5
02	Wait for CS5	1-III	n_5
03	Wait for CS5	1-III	n_5
04	Wait for CS5	1-III	n_5
05	Wait for CK1	2-III	n_2, n_5
06	Wait for CK2	2-III	n_2, n_5
07	Wait for CK3	2-III	n_2, n_5
08	Wait for CS1	3-III	n_2, n_5
09	Wait for CS2	1-X	n_3, n_5
10	Wait for CS1	1-X	n_3, n_5
11	Wait for CS2	2-X	n_4, n_5
12	Wait for CS1	2-X	n_1, n_4, n_5
13	Wait for change-over	3-X	n_3, n_5

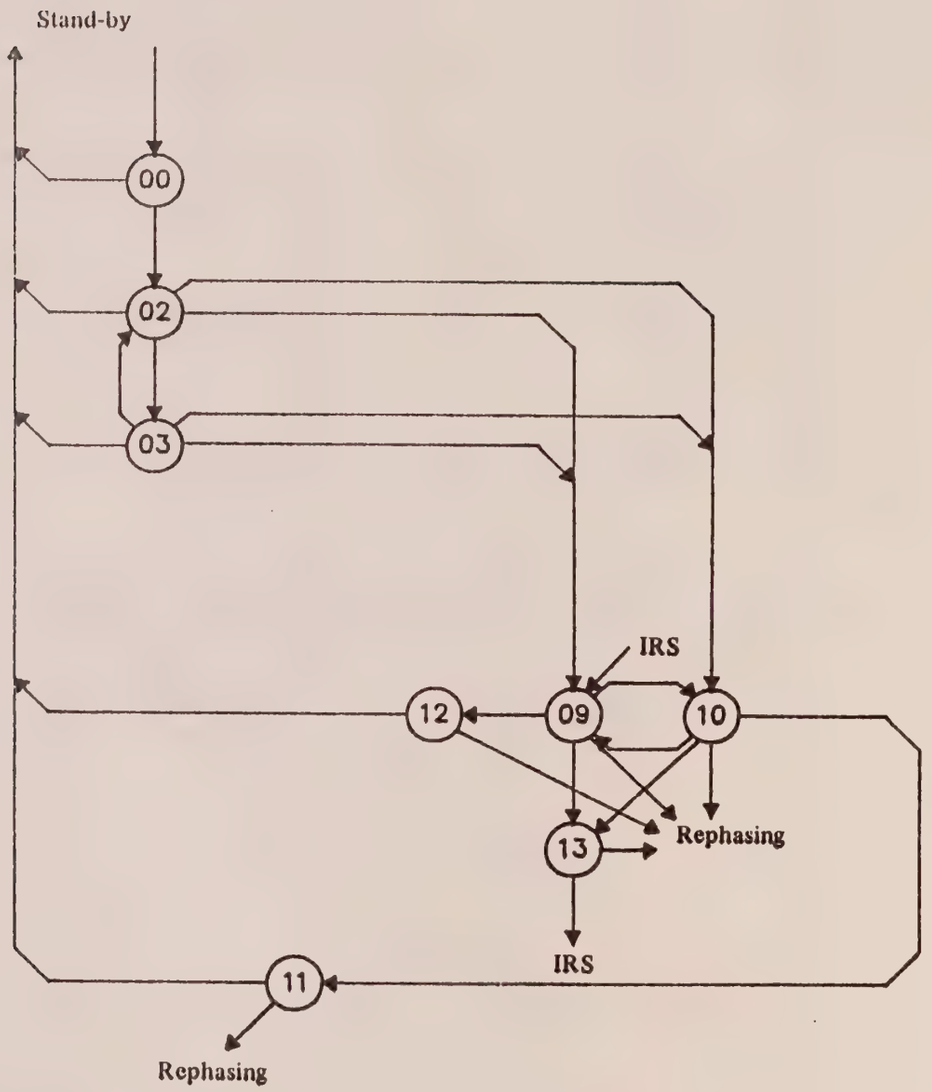
Supervisory counters

n_1 = 128 cycles
n_2 = 32 cycles
n_3 = 32 cycles
n_4 = 4 cycles
n_5 = 32 cycles

APPENDIX XII

PHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLING STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE ISS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 3 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	M4 idle	1-IV	n_1
02	Wait for CS1	1-IV	n_0
03	Wait for CS1	1-IV	n_0
09	Wait for CS2	1-X	n_3
10	Wait for CS1	1-X	n_3
11	Wait for CS2	2-X	n_4
12	Wait for CS1	2-X	n_1, n_4
13	Wait for change-over	3-X	n_3

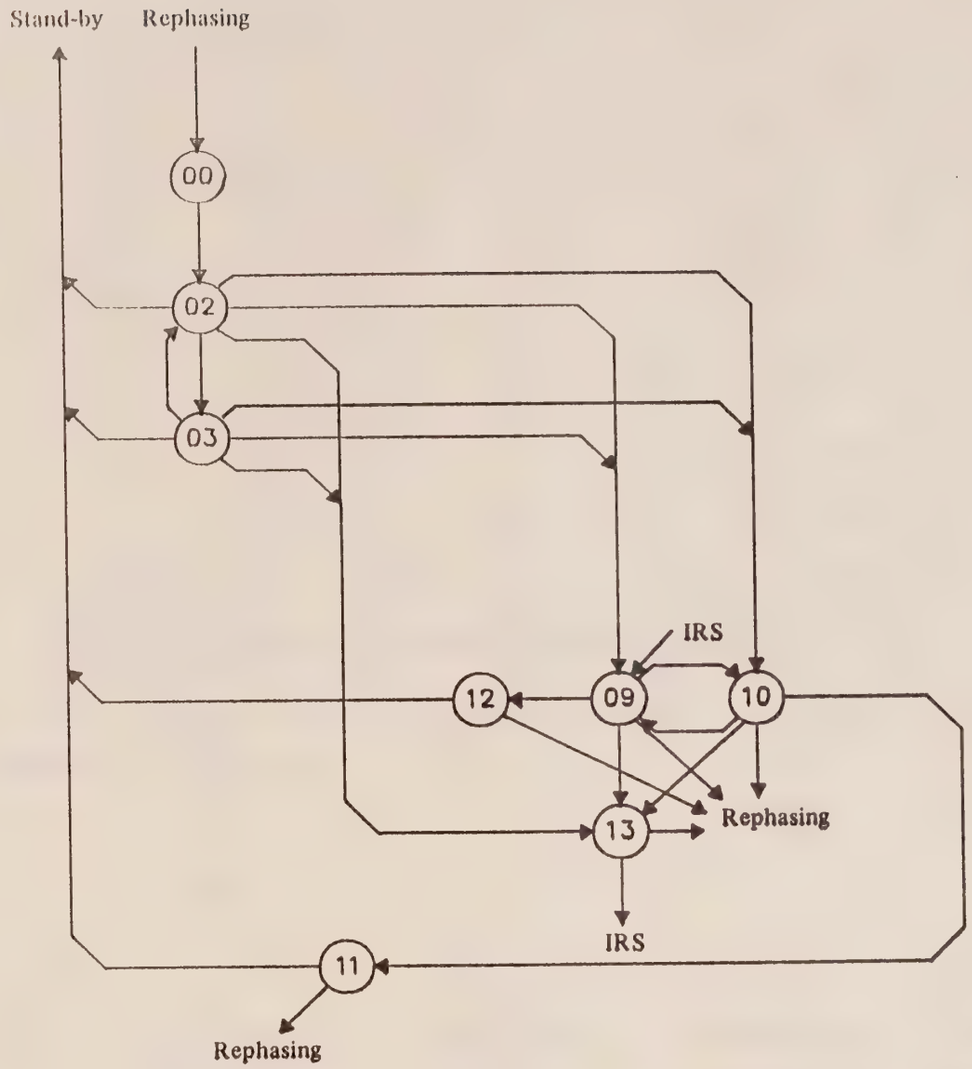
Supervisory counters

n_0 = 128 cycles
n_1 = 128 cycles
n_3 = 32 cycles
n_4 = 4 cycles

APPENDIX XII

REPHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLING STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE ISS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 4 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	MR4 idle	1-V	n_5
02	Wait for CS1	1-V	n_5
03	Wait for CS1	1-V	n_5
09	Wait for CS2	1-X	n_3
10	Wait for CS1	1-X	n_3
11	Wait for CS2	2-X	n_4
12	Wait for CS1	2-X	n_1, n_4
13	Wait for change-over	3-X	n_3

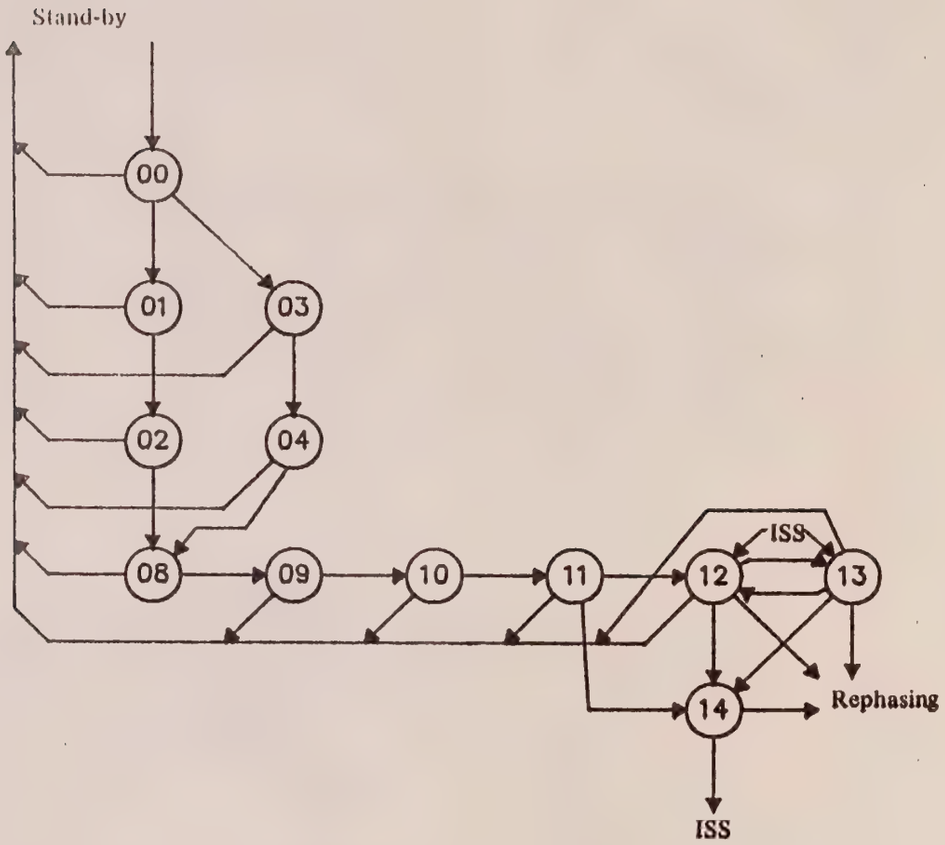
Supervisory counters

n_1 = 128 cycles
n_3 = 32 cycles
n_4 = 4 cycles
n_5 = 32 cycles

APPENDIX XII

PHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLED STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE IRS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 5 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	S7 idle	1-VI	
01	Wait for CB2	1-VI	
02	Wait for CB3	1-VI	
03	Wait for CB3	1-VI	
04	Wait for CB1	1-VI	
08	Wait for ID1	2-VI	n_2
09	Wait for ID2	2-VI	n_2
10	Wait for ID3	2-VI	n_2
11	Wait for EOI	3-VI	n_2
12	Wait for block 1	1-XI	n_3
13	Wait for block 2	1-XI	n_3
14	Wait for $\beta\alpha\beta$	2-XI	n_3

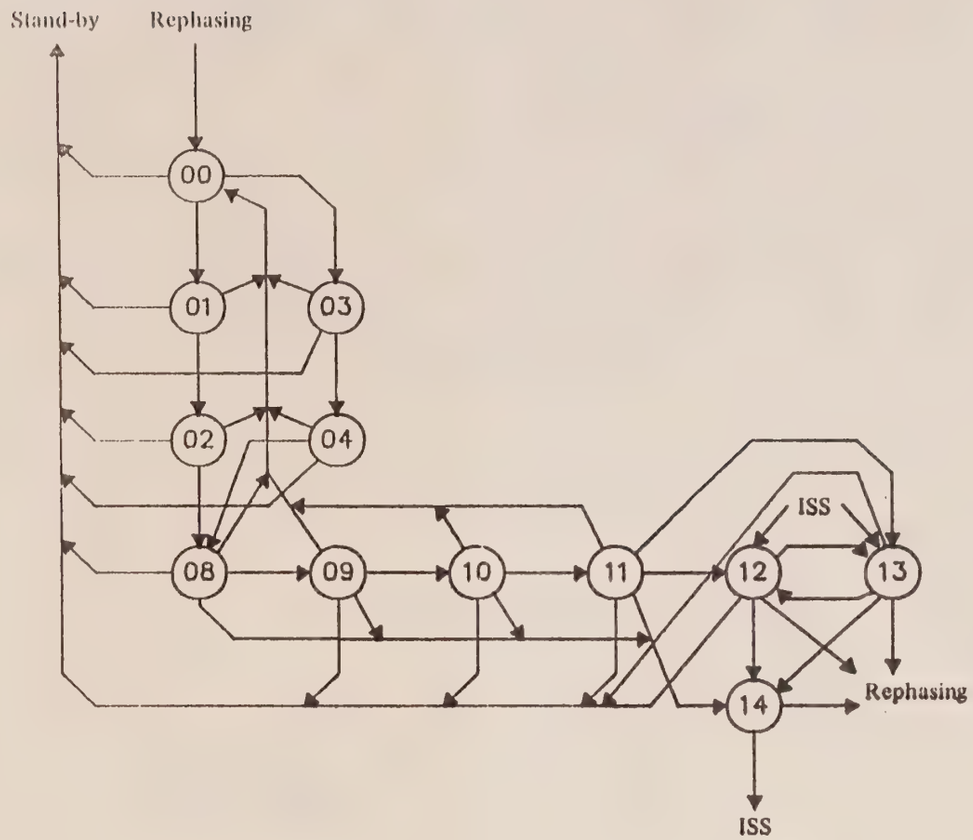
Supervisory counters

n_2 = 32 cycles
n_3 = 32 cycles

APPENDIX XII

REPHASING PROCEDURE WITH AUTOMATIC IDENTIFICATION IN THE CASE OF A 7-SIGNAL CALL IDENTITY (CALLED STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE IRS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 6 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	SR7 idle	1-VII	n_s
01	Wait for CB2	1-VII	n_s
02	Wait for CB3	1-VII	n_s
03	Wait for CB3	1-VII	n_s
04	Wait for CB1	1-VII	n_s
08	Wait for ID1	2-VII	n_2, n_s
09	Wait for ID2	2-VII	n_2, n_s
10	Wait for ID3	2-VII	n_2, n_s
11	Wait for EOI	3-VII	n_2, n_s
12	Wait for block 1	1-XI	n_3, n_s
13	Wait for block 2	1-XI	n_3, n_s
14	Wait for $\beta\alpha\beta$	2-XI	n_3, n_s

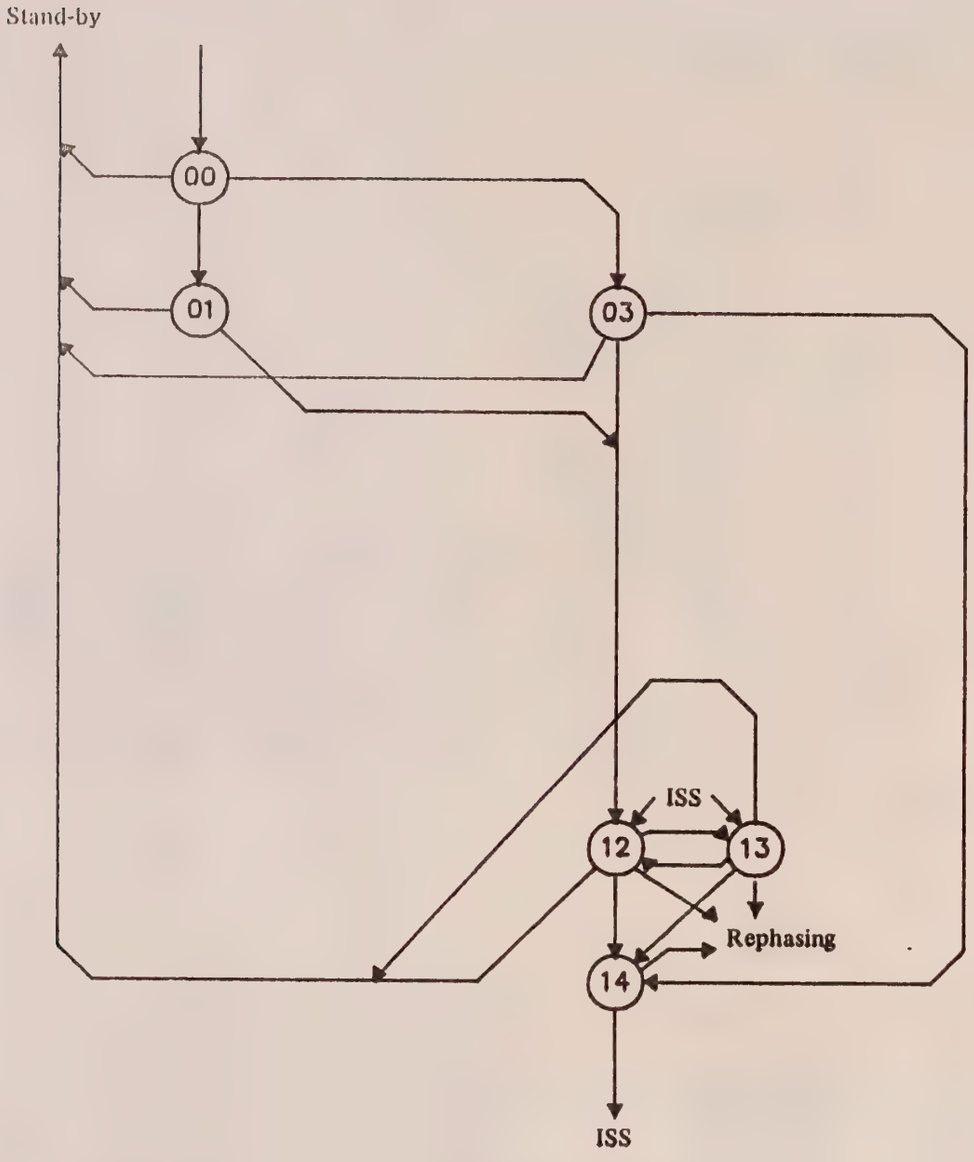
Supervisory counters

n_2 = 32 cycles
n_3 = 32 cycles
n_s = 32 cycles

APPENDIX XII

PHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLED STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE IRS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 7 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	S4 idle	1-VIII	
01	Wait for CB2	1-VIII	
03	Wait for CB1	1-VIII	
12	Wait for block 1	1-XI	n_3
13	Wait for block 2	1-XI	n_3
14	Wait for $\beta\alpha\beta$	2-XI	n_3

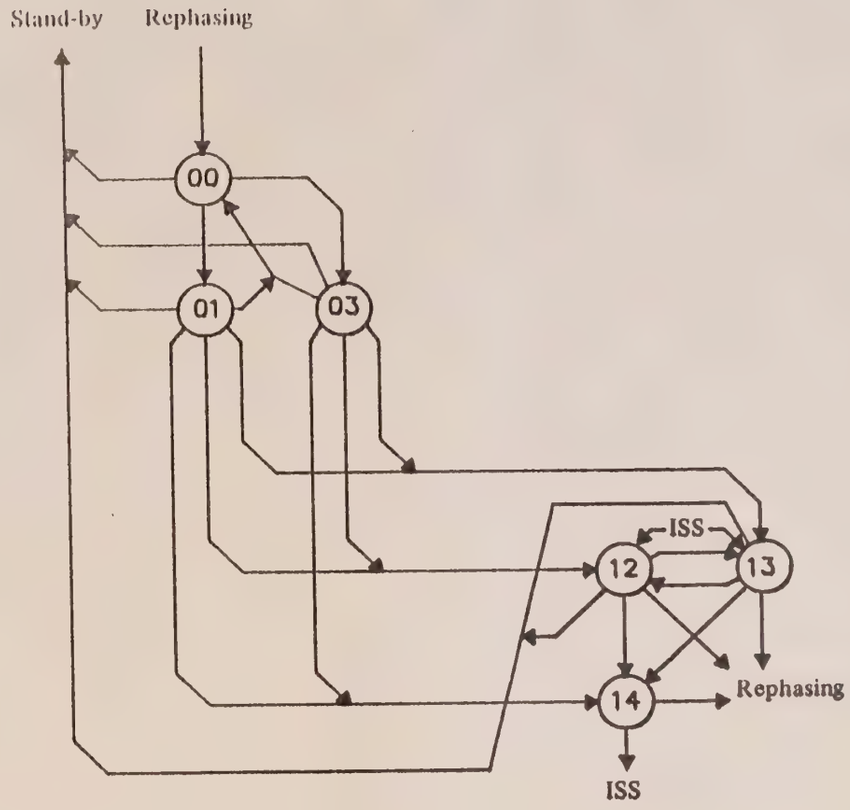
Supervisory counters

n_3 = 32 cycles

APPENDIX XII

REPHASING PROCEDURE WITHOUT AUTOMATIC IDENTIFICATION IN THE CASE OF A 4-SIGNAL CALL IDENTITY (CALLED STATION) AND TRAFFIC FLOW IF THE STATION IS IN THE IRS POSITION (STATE OVERVIEW DIAGRAM)

Sheet 8 (of 8)



State number	*State description*	*Sheet reference*	*Counters running*
00	SR4 idle	1-IX	n_5
01	Wait for CB2	1-IX	n_5
03	Wait for CB1	1-IX	n_4
12	Wait for block 1	1-XI	n_3, n_5
13	Wait for block 2	1-XI	n_3, n_5
14	Wait for $\beta\alpha\beta$	2-XI	n_3, n_5

Supervisory counters

n_2 = 32 cycles
n_3 = 32 cycles
n_4 = 32 cycles

TexNet Users Manual

1.0 The basic design philosophy of TexNet is of an open, inexpensive, multi-resource, high speed "backbone" with access through multi-connect capable local nodes. On the high speed side, the design goal has been a 9600 baud capable system. For local access, compatibility with the typical 2 meter AFSK/FM station was assumed as an operational norm. The system also had to be totally compatible with both versions of the AX.25 protocol specifications for user connection. With these general requirements, TexNet has been designed and tested to enable all users to take advantage of this high speed, full protocol protected packet network system.

TexNet Node Services:

2.01 There are several services possible on each net node. Each node can be programmed to supply the local user access to a digipeater, a weather information service, 2 conference bridges, TexNet access, a local console, and a debugger module. Use of all of the services can occur without interfering with any of the other services. For example, the node can simultaneously appear to be a digipeater to some users, a TexNet node to others and a conference bridge to yet another group of users.

2.02 Network operation is available through one SSID (-4 is what TPRS is standardizing on in Texas). The network software supports 256 nodes within one network. Other WB5PUC/N5EG protocol networks like TexNet can be connected together through a node operating as a "network gateway" to more nodes. Inter-network linking should not require a special gateway.

2.03 On the user port, a maximum of 20 users may be connected to all of the node's SSIDs at any given time. Operation of each of the node functions is slightly different but all are very simple to use. In the following, TexNet network commands and functions will be described, then the local services, in order of standardized SSID.

TexNet USER COMMANDS:

3.01 The station connects to the node using the -4 SSID. c WA5XYZ-4

At the network prompt: NETWORK CMD? the user can issue one of a few commands CIRCUIT, HELP, MESSAGE, STASTISTICS, LOCATIONS or ? by typing the command in full or the first letter in upper or lower case.

CIRCUIT

4.01 Circuit is used to make connections to remote users via the network. The following example shows the entire sequence from the first connection to a network node. For instance to connect to K5BOY in the Houston area from WD5HJP-9 in the Dallas area, the sequence would be: c N5EG-4 (from WD5HJP-9, to connect to network node). The user's (WD5HJP) TNC sends to his terminal: ***Connected to N5EG-4 The node sends to the user:

N5EG-4 Virtual Connection 02 at 23:55:45 on 1/28/87

***Welcome to TEXNET V1125-WB5PUC ***

NETWORK CMD? At the "NETWORK CMD?" prompt WD5HJP-9 sends: c K5BOY @ HOUSTON

4.02 TexNet at that point takes over, the connect request packet is sent to the node Houston and that node makes a connect attempt to K5BOY. If the network makes the connection, the originating user sees

YOUR CONNECTION IS ESTABLISHED (from the network)

The receiving station, K5BOY, will see

***Connected to WD5GAZ-4 (from the TNC showing layer 2 connection and the callsign of the Houston TexNet node). Then the station K5BOY will see

*** LINKED to WD5HJP-9 AT DALLAS VIA TEXNET ***

from TexNet. At that point the 2 users are operating as if simplex and the network maintains the connection automatically. The ***LINKED to line has been used to maintain compatability with W0RLI formatted mailboxes.

4.03 If K5BOY wasn't within range of the network node but could be reached via a digi then the circuit request string would possibly read: c K5BOY v IAH @ Houston

Connections through 2 digipeaters are possible and the limit at either end of the network connection. Either aliases or callsigns can be used to make the connections.

4.04 Disconnecting from the network is done by placing the user's TNC into command mode and typing d for disconnect. The network will automatically disconnect the remote user from the remote node.

4.05 Connections through the secondary user ports is possible either in origination or respond mode. The user to force a connection through a portother than the primary user port appends a comma and the physical channel number to the nodename. In this example the user is forcing the connection request through a second user port and digipeating through a digipeater on that port's frequency.

c W5ABC v K6XYZ @ PLANO,2

The designations for the ports are:

0--Network backbone

1--Primary User port (typically 1200 baud on 2 meters) The user port is not limited to 1200, it can be 1200, 2400, 4800 or 9600. Whatever the NCP board has been strapped for. Modulation is dependent on the modem in use.

2--Alternate User port (this can be optioned like the primary port)

3--Currently not in use. The software has the potential of supporting 8 ports.

HELP or ?

Contd

5.01 Help when typed in full or just a h or H or a ? at the network command prompt returns a menu listing the user commands. From the node: VALID COMMANDS ARE:

CIRCUIT
STATISTIC
MESSAGE
LOCATIONS
HELP

PLS REFER TO USER MANUAL

LOCATIONS

6.01 The user command LOCATIONS returns a menu listing all nodes on the network by name. The convention on TexNet is place names. For example: LOCATIONS SERVED BY THE NETWORK ARE:

MURPHY
DALLAS
PLANO
TESTBED
GARLAND
TI

MESSAGE

7.01 MESSAGE connects the user to the Packet Message System (PMS) module that is designated as the message server for the network. At the prompt NETWORK CMD?, the user types: M, the network automatically routes the user to the node assigned as the message server resource for that part of the network. The PMS is the system module that operates as a multi-connect mailbox as well as providing the emergency real time transfer and store functions for emergency traffic operations. The command stucture once in the PMS system is a subset of the W0RLI command set.

Packet Message Server

8.01 After connection through the network to the Packet Message Server (PMS), the PMS returns to the user:
LAST ACTIVITY WAS 02/22 AT 22:43 (FOR EXAMPLE)
If there are any messages on the system with your call as the addressee then another few strings may be listed detailing them as here:

```
MSG# TYPE   TO      FROM      AT       DATE     TITLE
1136 *      N5EG  0 WD5HJP0 DALLAS  02/22 15:14 NCP2 PARTS LIST
```

The asterisk in the type column indicates the message has been read by the addressee. Types include B(ulletin), P(rivate) and T(raffic). Standard non-private messages don't have an indicator. To & From are as expected with callsign extensions added. AT indicates the network node or BBS the message originated from.
After the listing, this next prompt indicates the system is awaiting your command:
FINISHED
COMMAND ? (B,K,L,R,S)
8.02 B(ye), K(ill), L(ist), R(ead) and S(end) all operate similarly to the now standard W0RLI command set. Bye generates a disconnect from the network. Kill will delete messages listed by number if you are the sender or receiver. Messages are automatically killed after 14 days on the PMS. Resetting TIME on that node to the wrong time can cause an unintentional automatic delete to occur.
8.03 Read operates by individual number, r 3605 will display message 3605 on the users terminal. R without a number will display the last message from the current message number pointer.
8.04 Send options are S callsign, SB (or ST) name/callsign, or SP callsign. S callsign is the standard message format. SB is the bulletin format for messages of interest to all system users. ST is the traffic designator. SP is a "private" message with access limited to it by the sender or receiver of the message. The callsign extension does not limit access to the message.
8.05 List operates by number of messages from the current pointer. If the user enters LL 10, the last ten message listings will be displayed. The largest number of listings possible in a single LL request is 24. A L 100 will list all messages from the latest to message number 100.
8.06 A character the PMS doesn't recognize as a valid command will return: BAD CHARACTER IN COMMAND LINE or BAD NUMBER
A Read, List or Kill command of a message number not on the PMS will return: MESSAGE NUMBER NOT ACTIVE
A private message not addressed to you will return: NOT YOUR MESSAGE

ERROR MESSAGES FROM A TexNet NODE

9.01 Because of the basic design of the network, there are two areas of operation where a connection failure or error message can occur. At the layer 2 level, the TNC to network node connection or on the layer 3 level, between network nodes.

For the user these 2 types of errors are reported differently.

LAYER 2 ERRORS

9.02 A layer 2 error is reported in plain text. These errors occur at either of the two nodes, origination or destination.

9.03 REMOTE USER NOT RESPONDING indicates the station requested in the CIRCUIT command is not available for a connection either through a busy disconnect from the remote user's TNC or simply no response because the remote TNC is off the air.

9.04 A garbled circuit command by the user will return to the user from the node a message detailing a typical circuit command by example:
NETWORK CMD? c wa5xyz ,jk (error is: ,jk without a via or an @ without a node name)
COMMAND NOT UNDERSTOOD.
AN EXAMPLE OF THE "CIRCUIT" COMMAND TO CONNECT TO W5ABC
IN HOUSTON WOULD BE:
CIRCUIT W5ABC @ HOUSTON

9.05 INVALID NODE NAME FORMAT Is the response to a remote connect request frame with too many digipeater aliases/callsigns in the string. Also the use of a digipeater string without a node listed will get the same response. The software programmed limit is 2 digipeaters both going in and out at the user ports of the network nodes.

9.06 INVALID COMMAND ENTERED Is returned by the node to the user when a command not recognized by the node is sent by the user.

9.07 NETWORK NOT READY Is the response when the user attempts to send more text to the remote user before the remote user has been connected to the remote network node.

LAYER 3 ERRORS

10.0 Most network errors are reported as 3 digit numbers. The two exceptions are the two error messages described below. These two messages are returned by the node the user has connected to. The later described Network Information Codes (NIC) are returned to the user by the network node at which the error occurs.

10.01 NO ROUTE TO THAT NODE indicates that the node of origination has no connection capability to the selected node on the network.

10.02 NODE NAME NOT VALID. ACTIVE NODES FOLLOW: is the text string the node returns when the user attempts to make a connection through a non-existant node name. When a user types a command string listing an uncoordinated node name, the node returns the above listed text string and then a listing of all the node names in use on the network.

10.03 On the network, different layer 3 status states or errors are indicated by Network Information Codes. These codes are returned by the node affected or by the next adjacent node attempting connection. Network codes are 3 digits and are generated by the layer 3 code. A typical network code response looks like:
NETWORK INFORMATION CODE 017 FROM BOONIES
The three digit code number is followed by the node that originates the code, BOONIES in this case. Each of the code numbers is usually selective enough to indicate a specific network failure.

10.04 The following Network Information Code numbers are possible common status indicators:
010 No network connects left in remote node during incomplete connect request. The remote node is loaded to capacity on the network backbone port.
011 Connect failure in remote node probably due to no frame buffers left in remote node. Too many outstanding frames to be delivered to other users will also generate this code.
012 Outgoing route failure during connect attempt. A network routing failure based on loss of a node in the route necessary to route the user's connection.
013 Remote user is already busy on the network. If the network user attempts to connect to a remote user who is already connected to the network node, the network node will not allow the connection.
016 Unknown terminal node found during transit routing. During transiting the system one of the nodes does not have routing information for the destination node listed in the packet it has received from the previous node.
017 No outgoing route to the next node found during transit routing. Normally it means that a network node has failed and no alternate route is up or exists.

TexNet ADMINISTRATIVE COMMANDS:

11.0 THESE ADMINISTRATIVE COMMANDS LISTED IN THIS SECTION SHOULD NOT BE ENTERED BY USERS. ENTERING THESE COMMANDS COULD HAVE DISRUPTIVE EFFECTS TO OTHER USERS ON THE NETWORK. THEY ARE LISTED HERE ONLY FOR YOUR UNDERSTANDING OF HOW THE SYSTEM WORKS AND FOR THOSE WHO WILL BE SERVING AS NETWORK ADMINISTRATORS.

11.01 Commands that control administration of the network are also issued when connected to the node at the SSID of -4. Each command has the structure of command(1 space) then the text string if listed. At the prompt: "NETWORK CMD?" the net sysop can issue one of a few commands STATISTICS, INIT, TIME, POINT, ROUTE, UNLOCK, or ALERT -ON/-OFF. The command can be spelled out in full or shortened to the first letter.

STATISTICS

11.021 Statistics is a command that returns information about accumulated node activity over a 24 hour period. It is setup so that all counters are zeroed at midnight local time at that node. The format of the information is listed below. Reading the statistical data does not clear those registers. The command syntax is: S(TATISTICS) @ DALLAS (the node name). The node will return the information to the sysop requesting it in the following format:

NETWORK CMD ? s @ dallas (to request stats at Dallas node)

STATISTICS FROM LAST MIDNIGHT TO 03:32 ON 05/21

FB AVAILABLE	0146
FB IN USE	0004
MAX FB USED	0007
TOTAL CONNECTS	0000
CONNECTS TO WX	0000
CONNECTS TO BRIDGE	0000
CONNECTS TO NETWORK	0000
NETWORK CKTS ACTIVE	0000
MAX NETWORK CKTS UP	0000
FB TX (10X),PCHAN 0	0135
PCHAN 1	0002
PCHAN 2	0000
FB RX (10X),PCHAN 0	0316
PCHAN 1	0000
PCHAN 2	0000
FB RE-TX D, PCHAN 0	0000
PCHAN 1	0000
PCHAN 2	0000

(FB stands for Frame Buffers, 200 byte buffers for received and transmitted frames. RE-TX D, is re-sent. The significance of (10X) is that TX and RX stats need to be multiplied by 10.) PCHAN IS PHYSICAL CHANNEL

11.022 Statistics from a previous day are saved in a buffer. To access them, the user issues a S Y @ (nodename) command. Format is identical with the current stat display. Note that the time runs from MIDNIGHT to 00:00.

NETWORK CMD ? s y @ testbed

STATISTICS FROM LAST MIDNIGHT TO 00:00 ON 05/21

FB AVAILABLE	0146
FB IN USE	0006
MAX FB USED	0036
TOTAL CONNECTS	0016
CONNECTS TO WX	0007
CONNECTS TO BRIDGE	0000
CONNECTS TO NETWORK	0002
NETWORK CKTS ACTIVE	0000
MAX NETWORK CKTS UP	0001
FB TX (10X),PCHAN 0	1045
PCHAN 1	0087
PCHAN 2	0000
FB RX (10X),PCHAN 0	2161
PCHAN 1	0528
PCHAN 2	0000
FB RE-TX D, PCHAN 0	0432

```
PCHAN 1     0004
PCHAN 2     0000
```

TIME

11.03 Time is used to set the real time clock at any TexNet node. The format is: DDMMYYHHMM, that's day, month, year, hour and minute, 2 digits each. 0110872134 is October 1, 1987 9:34 in the evening. Seconds are set at 00 when the time command is executed. For example: TIME 0110872134 @ DALLAS sets the date and time at the DALLAS node from anywhere in the network. If the time string is not entered, the time is set at the local node to match the time from the listed remote node.

INIT

11.04 This command does a software reset of the TexNet node. Time and statistics are zeroed at startup. Any packets pending or in transit through this node are deleted for both the network and local services. A new routing table is re-intialized, the old table is erased. INIT @ GARLAND will reset the GARLAND node from any other node in the network. Please note that this command dumps all current traffic in the node, terminates all connections in progress going through the node and takes the node out of the network until it has builtup a new routing table.

ALERT -ON/-OFF

11.051 This command is used to disable the automatic disconnect timers on the user ports of all the network's nodes. It allows all stations connected to the network nodes including the conference bridges to remain connected without disconnecting due to inactivity. It is suggested that this command be used ONLY during emergency situations.
11.052 The auto-disconnect timer can be disabled during network emergency operations by issuing an ALERT -ON when at the network command prompt. After connection to a network port and at the "NETWORK CMD?" prompt, the net control station sends ALERT -ON. This command places the ENTIRE network into an ALERT ON status. Users issuing ALERT -ON to a network command prompt see:

```
ALERT STATUS UPDATED
```

11.053 Other stations on connecting to the network receive a message after the initial greeting banner from the node as in this example:
PLS DISCONNECT UNLESS YOUR TRAFFIC IS RELATED TO THE NETWORK ALERT IN PROGRESS FROM DALLAS (nodename is DALLAS, it changes to indicate where alert was turned on)

11.054 To re-enable the timers and return the network status to normal, the control station must reconnect to a network port SSID and issue the command ALERT -OFF to re-enable the network auto-disconnect timers. ALERT -ON enables the PMS real time message transfer mode for stations connected to the PMS message server.

ROUTE LIST:

11.061 Route is a command to read a node's routing from a network administrative node. The user issues a r at the network prompt and will receive a table like below. It is a localized command. Essentially the table changes organization order but the information will be identical at each node.

```
NETWORK CMD ? r

LOCATIONS SERVED BY THE NETWORK ARE:

 004 000 000 000 000  MURPHY
 006 006 002 001 003  DALLAS
 005 001 002 006 002  PLANO
 001 001 001 006 002  TESTBED
 002 002 003 001 005  GARLAND
 003 001 004 000 000  TI
```

11.062 In the above table, Murphy is the node connected to and the r command was issued to it. The command is a local command and a nodename isn't necessary. To read the table, from left to right, the columns are: node number of the nodename listed on the far right, the primary via node, number of nodes on the primary path, secondary via node, number of nodes on the secondary path, and nodename for the remote node.

11.063 The column with the number of nodes on the path is weighted with a factor when the network function is on the same port as the user access to the network and the network link is a 1200 baud link shared with the user access function. In the example above, TI is a TNC2 type test node that operates only at 1200 baud with network functions and the user functions on the same port and frequency. In the other nodes the network function takes place at 9600 baud on a backbone separate from

user access. The weighting will force a 1200 baud link to become a secondary route if there is any other higher speed network link available.

UNLOCK:

11.071 This command is used to enable and disable the protection on the node's point enable/disable commands. Usually, the most sensitive of the administrative commands cannot be issued to a node by the typical commercial TNC. Typically the controlling node or network sysop will be using a TexNet EPROM to issue the point commands. To facilitate an authorized user's control over a single node's controlled points and the equipment controlled by those "swiTches", the UNLOCK command allows control point access through a standard TNC.

11.072 The user issues the UNLOCK command through the network or the local user port. The node responds with five numbers. The authorized user then responds with another UNLOCK command and with 5 corresponding key characters on the same line. The authorized user/sysop then has control over the control points. Each node's control points are independently controllable.

11.073 Syntax is UNLOCK @ XYZ. The named node responds with five numbers. The user then responds with UNLOCK (five alphabetic characters) @ XYZ. If the characters match the expected five alphabetic characters then the user is allowed access to the node's control points.

POINT:

11.081 The point command controls 13 pairs of input & output bits on each NCP board. Each output bit can be monitored using the point status command. As an output, each bit can be independently enabled or disabled. The point command allows external equipment connected to the NCP to be turned on or off. The UNLOCK command must be used first by those authorized users without a TexNet format TNC to enable their use of the point command. All other users get a prompt: INVALID COMMAND

11.082 Point Enable 1 @ Garland (or P E 1 @ Garland) will set the first control point on the NCP at the node located at Garland. Point Disable 1 @ Garland (P D 1 @ Garland) will reset the same control point. After execution of either command, the station originating the point command receives a status update:

Control Points at Garland Are

Point:	1	2	3	4	5	6	7	8	9	10	11	12	13
Input:	E	D	D	D	D	D	D	D	D	D	D	D	D
Output:	E	D	D	D	D	D	D	D	D	D	D	D	D

The E indicates enabled/set, D disabled/reset. At any time, the point status can be returned by Point Status @ Garland or P S @ Garland.

LOCAL SERVICES

12.01 -0 Digipeat operation, exactly as any other digipeater. The node recognizes its call and alias, for example: WA5XYZ-0 or WA5XYZ or ABC all can be used to digipeat through the node WA5XYZ. An alias can be programmed into the node. Connect request frames attempting to digipeat through a TexNet node with more than 4 digipeaters listed in link fields of received frames are discarded. Use of the node as a wide area digipeater or inter-connect DX digipeater is counter-productive to network node throughput.

12.02 -1 Weather information option. This operates by connecting to it. "c WA5XYZ-1" will get you the weather machine. Operation of this option is thru connection to the weather bureau's Baudot wire teletype service. It requires custom programming due to the regionally specific services offered by the NOAA. This SSID can also be used as a digipeater for those owners that request it.

12.031 -2 & -3 Conference Bridge. The user connects to the bridge by the usual connect sequence "c WA5XYZ-2" or "c WA5XYZ-3". The two SSID's are totally separate bridges. Each station wishing to take part in a roundtable needs to connect to the previously agreed upon bridge SSID. The bridge will not pass connect request frames like a digipeater.

12.032 When at least 2 stations are connected and a packet is received by the bridge, the packet is duplicated, each duplicate is re-addressed, and a source listing by call is placed at the head of the packet. Then each packet is sent with repackaged packets to all the stations connected to the bridge. Full protocol operation is maintained with the bridge on transmit and receive. Unprotocoled transmissions to the bridge are ignored. Requests from the bridge for retries on packets the bridge receives in error are automatic. For those stations on the receive side, it will retransmit packets that fail to be "ack'ed" by each receiving station.

12.033 The one user command on the conference bridge is a Control-U. If a control U is sent by any of the connected stations to the bridge, the bridge will return to that one station a listing of all the stations connected to that bridge at the time the request was received by the bridge. Control-U can be used at any time by any of the stations connected without interrupting operation of the bridge.

12.04 -5 Local console, local connects or network connects thru another node are possible via this SSID. Other stations may also connect and communicate via this SSID if there is an operator at the local terminal.

12.05 -6 Debugger module, network coordinators connect thru the network to this module to do long distance diagnostic work.

The TexNet NCP Hardware Design:

13.01 A brief description of the Node Control Processor (NCP):

13.02 The CPU is a Z-80A, running at 4 mHz. Serial synchronous data is handled by a SIO-2 for both ports at 1200 & 9600 baud. Baud rates for each SIO port are individually programmable via strap options for 1200, 2400, 4800 or 9600 baud operation. Timing of the interrupts and real-time functions are handled by a CTC hardware timer chip. Memory for frame buffers and temporary program use is supplied by one 32K x 8 static ram chip and one 8K x 8 static ram chip. Program storage for the WB5PUC software is in a 32K EPROM, a 27C256. The address decoder is designed to lockout address overlap between the 40K ram and 24K rom portions of the 64K memory map.

13.03 Standard modem complement included as part of the NCP board is a 1200 baud AFSK modem and the 9600 baud FSK modem for the network backbone (this modem is capable of 4800 baud also). Both modems have a state machine EPROM as part of their circuitry simplifying NCP layout and enabling easy modem and baud rate changes.

13.04 As a separate board but a critical component, is the uninterruptable power supply/battery charger circuit suitable for a 10 amp/hour, 12 volt Gelcell. The entire NCP, modem assembly and the two radios are powered by this specially designed circuit. The supply is designed to supply 6 to 8 amps to the 2 radios used in the node iaddition to the 2 amps maximum current requirements for the NCP and modems. During AC power loss, the power supply automatically switches to battery operation without an interruption.

13.05 An option to the basic NCP is a second SIO-2 that allows a third radio channel and an asynchronous terminal to be hooked up locally. The async serial terminal port option and the third sync serial radio port are programmable at the same rates as the primary serial ports. Another option is an add-on daughter board for a simple 3 chip CMOS interface to the hard disk controller, expansion 8-bit control/status port, and assembly used for a Packet Message System (PMS).